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COMPUTERWORLD

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NEWSPAPER

TOP OF THE NEWS

The IRS picked a winner of its 15,000-unit laptop micro contract, IRS officials said last week. Industry observers expect IBM to be named as the supplier, and, perhaps next week, to unveil its long-rumored Clamshell. **Page 2.**

■

William Norris moved last week to shake up the declining fortunes of the Control Data he founded 29 years ago. **Page 134.**

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Tolerant Systems, Inc. adds fault tolerance features to its products. **Page 37.**

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The U.S. Department of Justice develops an on-line data base to track antitrust litigation, replacing index cards. **Page 25.**

■

Apple Computer's newest machine may not be compatible with all existing Macintosh software and peripherals. **Page 5.**

■

A Xerox spin-off offers to put Ethernet on wire as well as hook into IBM's Cabling System. **Page 8.**

■

Fourth-quarter financial reports and announcements of layoffs worldwide are expected from Intel this week. Indications are that the company could lay off 700 workers or more.

■

IBM watchers say the firm will announce its first reduced instruction set computing machine next week. The RISC offering is said to be a high-end stand-alone engineering workstation that is expected to shake up the market dominated by Apollo and Sun. Carnegie-Mellon University has set an announcement for Wednesday, and it is believed researchers there will unveil an operating system for the new device. Also expected are 10% or better price cuts on the 3080 mainframe series; slight price cuts to the 3090 systems; 4381 mainframe enhancements; and improvements to the company's DB2 data base

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Justice OKs piracy shield; vendors balk

By Bryan Wilkins

WASHINGTON, D.C. — The U.S. Department of Justice last week said it will not challenge a software industry group in its push for a hardware-based lock-and-key system standard to protect software programs from illegal duplication. But several major software companies that had previously supported the scheme have begun to back away from the proposed standard in response to initial user hostility.

The prime mover in the drive to thwart illegal duplication of software programs is the Association of Data Processing Services Organization, Inc., representing computer software and service organizations. The association has spearheaded a year-long drive to end illegal duplication of software programs, claiming that the practice cost the industry $800 million in 1985 and $1.3 billion between 1981 and 1984.

Last week, ADAPSO announced it will release shortly a proposed draft standard of a lock-and-key system based on a hard-

See **JUSTICE** page 6

Honeywell phasing out Multics line

By Paul Korzeniowski

A small group of loyal users will be informed by Honeywell, Inc. today that the company will no longer explore alternatives for extending the life of its 16-year-old Multics operating system.

Members of Honeywell's Large System Users Association, meeting in Hawaii, will be told that Honeywell has decided to cancel some long-term Multics projects because the small user base is not expected to increase sufficiently to justify costs. The company will attempt to migrate users to a new product line that it intends to announce later this year.

Despite a user base of less than 60 firms, Multics has acquired a devoted following that includes Ford Motor Co. Although Honeywell said it intends to continue with some planned Multics enhancements, many users in the U.S. and in Europe are outraged by the action (see story page 15), and some are already planning to switch to other vendors.

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Data base unit uses 80286 chip

By John Gallant

LOS ANGELES — One of the leaders of the fledgling data base machine market, Teradata Corp., last week unwrapped an Intel Corp. 80286-based Data Base Computer that more than doubles the performance of its earlier relational data base processor for IBM mainframes.

Teradata's introduction of the DBC/1012 Model 2, analysts said, strengthens the firm's ability to market its data base machines in the high-end IBM world. Data base machines — specialized back-end processors embodying relational data base management system software — offer significantly higher performance than software implementations of relational DBMS technology, with correspondingly higher price tags.

According to Michael Motto, director of technology management at Schering-Plough Corp. in Madison, N.J., his company tested the performance of the Model 2

See **DATA** page 4

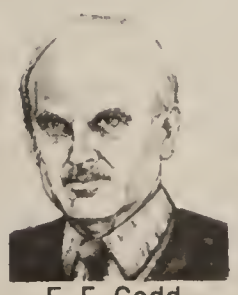
CW EXCLUSIVE

Strained relations: DBMS debate turns bitter

By John Gallant

A controversy currently raging in the data base management world dramatically illustrates that, though nearly 16 years have passed since the birth of the relational model for data management, time has not cooled the heated debate over the capabilities of relational systems and — perhaps more important — just what constitutes a relational data base management system in the first place.

Battle lines in the relational fray have been drawn between former IBM researcher E. F. Codd, who argues for strict adherence to relational concepts, and software vendors, which must implement those principles in products that address users' current concerns. The gulf that has opened between the caretakers of relational theory and those who implement the technology has left many users confused and has lent a hollow ring to the marketing claims of vendors now elbowing for position in the DBMS market.



E. F. Codd

The latest round in the debate was sparked by Codd, who drafted the original relational model. Since the concept of relational data management debuted in 1970, the majority of computer users, as well as vendors and academicians, have embraced Codd's relational concept as the favored foundation for the future of DBMS.

But in a two-part *Computerworld* article [In Depth, Oct. 14; Oct. 21], Codd set out 12 rules of relational architecture and then asserted that "no existing DBMS product can honestly claim to be fully relational." Codd, who along with Chris Date cofounded the Relational Institute and the Codd & Date Consulting Group, then measured three leading DBMS programs against his 12 standards.

See **DBMS** page 8

Vendor-initiated standards group provokes admiration, skepticism

By Clinton Wilder

A new vendors' organization being formed to promote the development and adoption of Open Systems Interconnect (OSI) and other data communications standards received mixed reactions from telecommunications users and industry analysts last week.

While praising the intentions of the Corporation for Open Systems (COS), most observers felt the 18-vendor consortium will not constitute the panacea for hardware, software and communications incompatibility among different vendors' products.

The group's first challenge, many believe, will be convincing IBM to join Digital Equipment Corp., AT&T, the BUNCH companies and other leading firms in the effort to make OSI and communications protocols such as X.25 true industry standards. IBM's proprietary Systems Network Architecture has been the standard interconnect method for Big Blue equipment, but IBM is noticeably absent from the 18 COS organizers.

For users, the chances for COS to succeed are uncertain. Some said they believe the effort to make the International Standards Organization's OSI model a workable standard will depend greatly on input from MIS and telecommunications directors in user organizations.

"I'm skeptical of any effort to develop standards that does not include user representatives," said Robert E. Bennis, manager of communications systems at Westinghouse Electric Corp. in Pittsburgh. "To this point, the vendors' direction has been to build fences around their own world for their own personal interest. This is definitely a step in the right direction, however." COS founders have promised some user participation, but the nature of it is unclear.

An IBM representative is scheduled to attend the first COS organizational meeting Jan. 23 in Washington, D.C., where the standards consortium will be headquartered. COS organizers hope to lure an additional 40 top vendors to join the group but insist that IBM will not be accorded special treatment. "We want them to be one among equals," said Jack Biddle, the COS organizer and president of the Computer and Communications Industry Association, which has consistently opposed IBM on trade issues.

Biddle said the goal of COS is to derive the most technologically workable elements of existing standards like OSI, set up laboratories to test products for their compatibility with the standards and establish a seal of approval so that users can trust that compatibility. The COS hopes to achieve its goals in four to five years, with annual budgets of $8 million to $10 million.

"We want to take the good work already done by independent standards writers and put it into products, so a standard isn't just something that sits on the shelf collecting dust," Biddle said. "The goal is to reach consensus where the technicians haven't been able to."

One leading OSI expert praised COS as the first vendor-initiated standards effort. "It's good to move the work away from a bunch of bureaucrats at the National Bureau of Standards to the people who really have a stake in it," said Harold C. Folts, founder and president of Omnicom, Inc., a Vienna, Va.-based OSI consulting firm.

IRS ready to award laptop pact

By Mitch Betts

WASHINGTON, D.C. — Internal Revenue Service officials said last week they may award as soon as next week a contract for 15,000 portable microcomputers and software to be used by IRS auditors. IBM will win the lucrative contract, although it has yet to announce a laptop micro, industry sources contended.

The IRS deal is expected to trigger the announcement of an IBM laptop, commonly referred to as Clamshell. Vendors and analysts said they hope an IBM laptop will spur greater demand for the small computing devices.

The agency's request for bids last April said the micros must have, at minimum, Microsoft Corp.'s MS-DOS operating system, 512K bytes of random-access memory, a 6-in. (diagonal) screen with 25 lines of 80 characters and an integrated disk drive for removable diskettes. The system, including a modem, must not exceed 18 pounds, the IRS document said.

James W. Lear, chief of the agency's evaluation branch, confirmed that there is an apparent winner of the contract. But, he said, approvals must still be obtained from the agency's computer policy board, legal counsel and the U.S. Department of the Treasury's procurement office.

Lear said the announcement of the contract award is expected next week. He and other IRS officials declined to elaborate. IBM spokesmen also refused to comment on widespread reports that IBM will unveil a number of products Jan. 21. International Data Corp. analyst Aaron Goldberg was among those who confidently predicted the IBM laptop rollout on that date.

Vendors said there is much speculation that IBM is the apparent winner of the IRS contract, but an IBM spokesman stated, "We have no knowledge of being a finalist or a winner."

"We hear that IBM is the winner, but we hear that mostly from reporters," said Pat Gallagher, sales manager at the federal sales office of Zenith Data Systems Corp. in Vienna, Va.

Zenith and Grid Systems Corp., which has been successful selling its laptops to the government, are also among the finalists in the contract bidding, officials at each firm said. AT&T Information Systems — which also has not announced its laptop product — would neither confirm nor deny that AT&T is another finalist.

The contract will put laptop micros in the hands of IRS field auditors so they can have access to the agency's mainframe computer files to conduct on-site tax audits and write reports [CW, Sept. 24, 1984].

Lear said the IRS conducted extensive functional tests and cost evaluations to select the winner, and it is confident it can win any legal protest that might be filed by a losing vendor.

Training and first delivery will begin 30 days after the contract award, with 300 units to be delivered within 60 days. Nationwide implementation will begin 90 days after contract award and will require delivery of up to 1,000 micros a month to various offices in the U.S. for a period of 12 to 18 months.

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THE BEST COMPOSER SHOULD HAVE THE BEST PIANO

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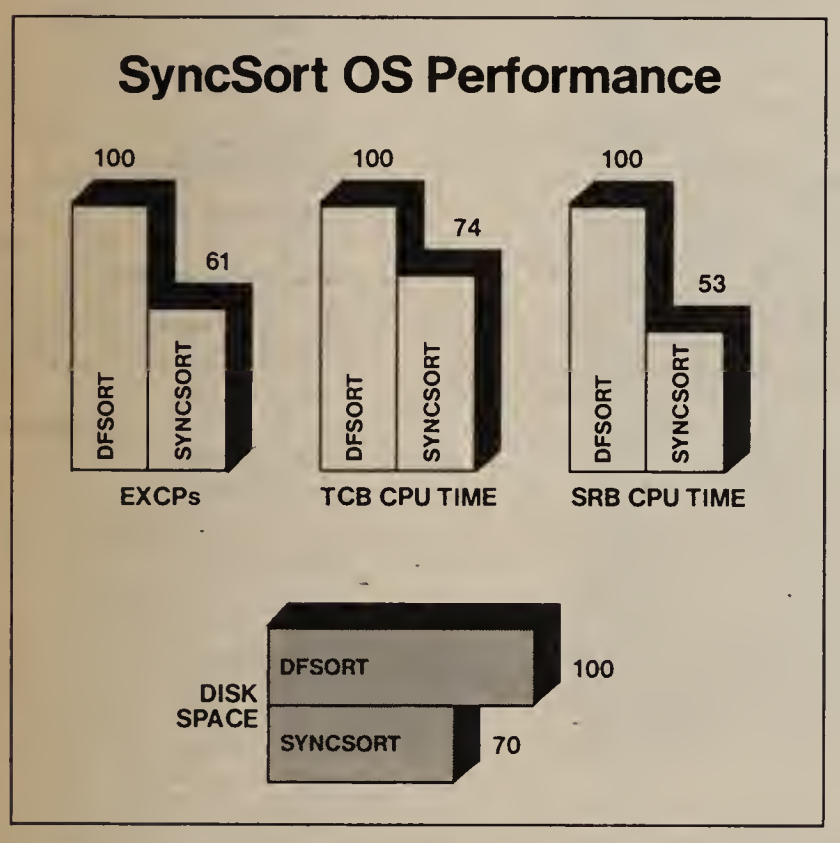

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Tymnet strikes deal for net interconnection

Southern New England to provide local access

By John Dix

NEW HAVEN, Conn. — In a deal touted as the first of its kind, Tymnet/McDonnell Douglas Network Systems Co. has agreed to interconnect its national packet network with the local packet net service of Connecticut-based Southern New England Telephone Co.

"This deal is a hallmark," said Clint DeGabrielle, vice-president of marketing and field operations for Tymnet, referring to ongoing negotiations that Tymnet and other carriers are involved in with local phone companies developing packet services.

The divested Bell operating companies — Southern New England was only partially owned by AT&T prior to divestiture — are particularly interested in interconnect agreements. They are not allowed to offer services that cross state borders or the boundaries of Local Access Transport Areas (LATA). LATA defines what is long distance within the former Bell operating companies' respective service territories.

Southern New England's ConnNet packet service will interconnect with Tymnet through a gateway that complies with the CCITT X.75 specification. Customers connected to either network can now transparently access resources supported by the other net.

According to DeGabrielle, both companies benefit from this agreement, as will their respective customers. "Southern New England provides us with universal local access in Connecticut. For us to provide that, we would have had to buy it from them anyway, and this way we can offer customers a single number for local access.

"Conversely, Southern New England can offer its customers a single number that will enable them to reach any place in the world. In the long run it should impact our rates favorably for the customer."

Asked if Tymnet was forfeiting the battle for customers in Connecticut and admitting it was better to cooperate than compete, DeGabrielle said, "I don't think it's necessarily a black-and-white situation. Are we going to lose revenue for some time? Maybe. But maybe we'll be able to leverage this so more revenue is generated from this geographical area."

The outcome will depend on how successfully the companies capitalize on the marriage and come up with applications to woo customers. To that end, the agreement also calls for a co-promotional effort, according to Bob Yoston, division manager of network services for Southern New England Telephone.

The deal does not preclude either party from entering similar agreements with other carriers. "This deal is a recognition of the fact that this marketplace requires interconnection and benefits from this kind of cooperative arrangement," DeGabrielle said.

Data base unit uses 80286 chip

From page 1

against that of the earlier release and experienced a nearly threefold improvement in performance. Schering-Plough was one of three beta test sites for the original model, which it has operated in a production mode for more than a year, and recently completed beta testing of the DBC/1012 Model 2 at its corporate data center in Memphis, Motto said.

Teradata, headquartered in Los Angeles, and Los Gatos, Calif.-based Britton Lee, Inc. are considered the leaders in the young market. To date, Britton Lee has focused primarily on the minicomputer marketplace. One analyst, H. Michael Braude, vice-president and director of the Gartner Group, Inc.'s Software Management Strategies Service, estimated last week that approximately 55% of the more than 500 installed Britton Lee processors are tied to Digital Equipment Corp. VAX machines.

Founded in 1979, Teradata has traditionally focused solely on IBM mainframe sites, a difficult market to penetrate as data base machines are seen by many analysts as representing a direct threat to sales of IBM processors. Teradata claims to have installed 21 of its original DBC/1012 data base machines, which were based on Intel's 8086 microprocessor. The Teradata processor was officially unveiled in September of 1984.

Offering connectivity to MVS- and VM-based mainframes, the DBC/1012 can be configured with from three to 1,024 processors. Each 80286-based processor represents roughly 1 million instructions per second (MIPS) of processing power. The DBC/1012 features two primary types of processors.

Interface processors (IFP) translate mainframe SQL data queries and communicate them to access module processors (AMP) through Teradata's proprietary Ynet architecture. Each AMP, configured with one or two disk storage systems, resolves in parallel all data requests. Data is transferred back to the host system through the IFP. The system's parallel processing capabilities enable it to perform relational DBMS tasks more swiftly than software-based data management systems. The DBC/1012 is fault tolerant and can be attached to multiple host systems. Users can add processors and disk storage as requirements increase.

The original data base machine installed at Schering-Plough supports information center applications for the company's marketing and personnel departments. Data requests are formulated through Artifical Intelligence Corp.'s SQL-compatible Intellect package on an IBM 3084 mainframe under MVS/XA. SQL requests can also be sent from microcomputer workstations attached to the mainframe via Micro Decisionware, Inc.'s PC/SQL-Link.

Schering-Plough's production and test machines currently boast four IFPs and eight AMPs each. A Teradata spokesman said that this configuration offers roughly 12 MIPS of processing power, 4G bytes of storage and 24M bytes of dynamic random-access memory.

"It is a trade-off," Motto said. "You pay more up front vs. the software approach. Relational is great for the end user, but it consumes a lot of processing power. The relational environment is dynamic, there are no predefined transactions. You are not sure what you will be asking the system to do. As your relational needs grow, along with the growth in use of other systems like IMS and CICS, the life cycle of your mainframe can be substantially shortened."

Motto said Schering-Plough also served as a beta test site for Release 2 of DBC/1012's operating software, which consists of host interface and relational DBMS software. Teradata's spokesman said Release 2 enhancements include changes in data formatting methods to reduce machine overhead by nearly 50% and the use of data base optimization techniques to improve performance. The spokesman said a typical 12-processor, 12-MIPS configuration with eight disk units and 4G bytes of storage is priced at $562,000. Processors and storage may be added at $39,000 per MIPS and $21 per megabyte, respectively.

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Apple's Macplus features more RAM, double-sided drive

Prime using machine to develop software

By Edward Warner
Computerworld News Service

FRAMINGHAM, Mass. — Macplus, the forthcoming enhanced version of the Apple Computer, Inc. Macintosh, will offer 1M byte of random-access memory (RAM), a double-sided 800K-byte diskette drive and a numeric keypad built into its keyboard, according to the editor of a Macintosh users' newsletter who has seen one of the new machines.

Other changes include a doubling of the Macintosh's read-only memory (ROM) to 128K bytes and the addition of a small computer systems interface (SCSI), which would allow the machine to use large-scale storage devices as peripherals, said "Macintouch" editor Rick LePage.

The machine's expanded ROM, LePage said, lets the Macintosh operating system support subdirectories of files, something already available to users of IBM Personal Computers. Support for subdirectories, he said, makes the Macplus "more efficient" than its predecessor but causes the Macplus to be unable to run many existing Macintosh programs.

"That would surprise me very much," responded Scott Schwarts, president of Symmetry Corp., which produces the Picturebase and Quickdisk Macintosh programs. Schwarts said he had heard that about 5% of the programs suffered "compatibility problems" with Macplus' Hierarchical File System, which creates the subdirectories. "In many cases," he continued, "it's only cosmetic."

LePage, meanwhile, said an additional disadvantage of the Macplus is that it uses DIN-type connectors, not standard Macintosh connectors, at its output ports. "Anybody who upgrades their Macintosh is going to have to buy new connectors" for their peripherals, LePage explained.

LePage said the faster disk access speeds and doubled memory provide improvements over the 512K Macintosh, the machine it will replace.

Apple, he added, is so solidly behind the Macplus that on Dec. 16, 1985, it stopped production of the machine's predecessor, the 512K Macintosh. The Macplus, he said, will be priced between $2,195 and $2,495.

LePage said use of an SCSI would permit the machine to be connected immediately to storage peripherals far larger than the 20M-byte hard disks currently available for the 512K Macintosh.

Microsoft Corp., LePage said, will be among the first to take advantage of the greater memory by adding a dictionary and style sheets to the Macintosh version of the Word word processing program.

For users, more "RAM helps those applications that seem to be landlocked," he said. It also means large programs can be resident in memory, something long-awaited by Macintosh users who dreaded their machine's slow drives.

TOP OF THE NEWS

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management system.

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This Tuesday, DEC will introduce what it calls "a major achievement in VAX-based technical workstations."

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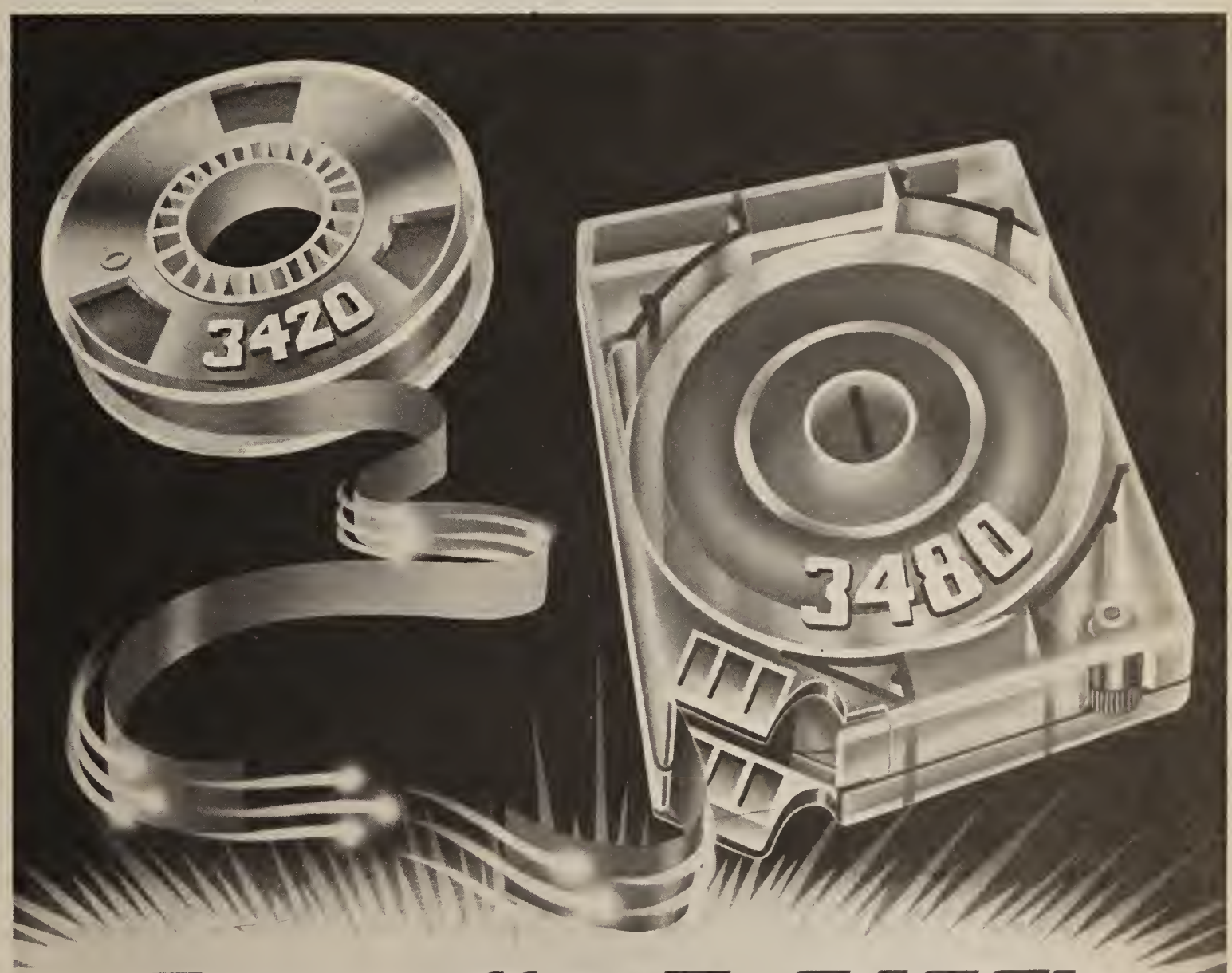
Wang Laboratories will join the parade of major vendors into the on-line financial quotation services businesses. In New York on Thursday, Wang is set to unveil subsidiary Wang Financial Information Services Corp., which will provide market quotes via the Wang Professional Computer. The system is based on Shark, a software package developed by New York-based Walsh Greenwood Information Systems, which Wang acquired last September.

■

The departments of Justice and Commerce are exploring what steps to take to change the terms and conditions of the AT&T divestiture order now 2 years old. Rodney Joyce, acting assistant secretary of commerce for communications and administrator of the National Telecommunications and Information Administration, said last week the two agencies "are working internally to find the proper approach" to change the decree's terms. NTIA favors an immediate suspension of the decree's ban on enhanced data communications services facing the divested Bell operating companies and is close to deciding its position on letting them offer limited long-distance services, Joyce indicated. U.S. District Judge Harold Greene would be the final arbiter of any move to alter the divestiture rules.

■

Spartacus Computers, Inc., which delivered less than a handful of IBM 4300-compatible mainframes before switching its efforts to communications products, agreed last week to be acquired by Fibronics International, Inc. Spartacus sells products to link IBM mainframes with other vendor systems via Ethernet.



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Workstation agreements set Sun against Apollo, DEC

By Rosemary Hamilton

In the 32-bit workstation market, Sun Microsystems, Inc. last week stole the show from archrival Apollo Computer, Inc. when Sun announced joint marketing agreements with two low-end supercomputers makers, one of which — Alliant Computer Systems Corp. — struck a deal with Apollo late last year.

The agreements bring Sun up to par with Apollo, since both will now be offering compute-intensive machines in their product lines. Industry analysts said the additional computing power is essential for the workstation vendors to compete with Digital Equipment Corp., which has been putting the squeeze on these two vendors since its introduction of a workstation product based on its successful Microvax II last year. DEC is expected to announce a workstation product this week.

Sun's deal with Alliant will be a joint effort, whereas Apollo will be reselling Alliant's FX series.

"The agreements are the answers to Apollo and Sun's prayers against the encroachment of DEC," said David Wu, an analyst with S. G. Warburg, Row and Pitman, Akroyd, Inc. in San Francisco.

The agreements also further Sun's efforts to promote its Network File System (NFS) as an industry standard. NFS allows users to access transparently files across networks of multivendor systems. Both Alliant and Sun's other new partner, Convex Corp., will implement NFS on their systems. Convex makes the C-1, a so-called Crayette computer because its architecture is based on the Cray Research, Inc. Cray-1 supercomputer. Sun, with a 32-bit workstation running under a derivative of the University of California at Berkeley 4.2 version of the AT&T Unix operating system, has been competing with Apollo to become the workstation industry leader. Apollo, which sells systems based on its proprietary Domain architecture, made a commitment to open architecture systems last year by introducing both Berkeley 4.2 and AT&T System V versions of Unix on its workstations. It also provided gateways to DEC's systems running under VAX/VMS, to IBM systems on Systems Network Architecture networks and to IBM Personal Computers.

Sun said it is negotiating with 30 vendors to license NFS, and so far "about a dozen" have licensed it.

"The issue here isn't as much Sun as it is the Network File System," said David Miccichi, vice-president of marketing and sales at Alliant. "We, along with other vendors, are cooperating to promote and foster the development of NFS as a standard."

In a prepared statement, an Apollo spokesman said, "We were notified by Alliant that they'd reached an agreement with Sun. Alliant has a popular product. We don't have much else to say." Apollo officials were not available for comment.

According to JoAnn Kahn, director of new business development at Sun, the two agreements are essentially the same. Both Alliant and Convex will first implement Sun's NFS on their systems. Then, Sun will work separately with both vendors to develop networking management software for a batch execution facility that will interact with Sun's technical workstations. The companies are also ironing out details for joint-marketing programs.

Alliant, for its part, said it sees no conflicts arising from the deals with both Apollo and Sun. "It's like comparing apples and oranges," Miccichi said. "The objective for Apollo is to become a full-line supplier. The objective for Sun is to foster NFS."

Justice OKs piracy shield

From page 1

ware peripheral device that connects to a microcomputer's RS-232 communications port. ADAPSO said the draft will be available for a 90-day comment period before further action to adopt any standard is taken.

In response to ADAPSO's standards push, the Justice Department said it would not oppose that effort. But the clearance of antitrust considerations is contingent on limiting the standard "to the physical connections and communications between parts of the authorization system and between the system and the computer." The department informed ADAPSO that the group may not standardize the entire software protection system or use standards as a means of excluding other types of software protection mechanisms.

> ***'We're going full speed ahead and expect renewed public debate as the draft gets around.'***
>
> — Dave Sturtevant
> ADAPSO

The two principal features addressed by ADAPSO's draft affect the physical size of the key that contains, in chip memory, a critical part of a software program's code — a part without which the program could not function — and the communications protocols governing the interactive function of the key's hardware key ring device with the RS-232 port on the micro.

Ironically, support for a hardware-based lock-and-key system has lost some of its support from software vendors in recent months. This comes as a result of surveys that indicate users were not receptive to the idea of attaching another component to their systems, especially a component that is interactively involved in communications through the RS-232 port, through which other peripherals such as printers and modems are connected.

Lotus Development Corp. of Cambridge, Mass., one of the original backers of the lock-and-key concept, said late last year [CW, Dec. 16] that it was dropping its support because of negative customer reaction. However, Lotus says it still sees advantages to hardware-based software protection systems.

"It's safe to say we have backed away from this at this time," Lotus spokesman Burke Rogers said last week.

A spokesman for Micropro International Corp., a San Rafael, Calif., software maker, said the company was following developments in the area of hardware standards for software protection mechanisms but was taking a wait-and-see approach for the moment.

According to Dave Sturtevant, director of communications at ADAPSO, the key aspect affecting acceptance of a hardware-based standard for software protection is whether the software industry is willing to embrace it and whether the added costs — an estimated $25 for a security system that includes a key, a key ring and the software lock — can be passed on to customers.

"Larger corporations may or may not want to implement a lock-and-key system at all. A vendor could say, 'I'll sell you X number of programs with the protection at a set price and without it at three times the price,' " Sturtevant said.

He added that one attraction of the lock-and-key system is that it can function to ensure data security in hard disk systems in multiuser environments.

Sturtevant said 15 major software companies have participated in the development of the draft standard about to be released, and another 150 vendors participated in two seminars held by ADAPSO to discuss the design of the lock and key.

Sturtevant downplayed the drop in interest in the lock-and-key software protection approach. Until the Department of Justice determined that the effort to develop a standard did not violate antitrust laws, ADAPSO was unable to push the idea, he said.

"We're going full speed ahead and expect renewed public debate as the draft gets around. Companies are going to look at the costs of the standard before they decide whether to embrace it," Sturtevant said.

Marv Goldschmitt, a former vice-president of Lotus and current chairman of ADAPSO's software protection committee, said industry hesitation about the lock-and-key system is more a reflection of the difficult market conditions facing the software industry and the desire of vendors not to alienate customers with software security schemes that complicate ease of use.

"The security of a program is an issue of authorization to use the program," Goldschmitt commented. "Copyright protection is not the only goal. I believe it is inevitable that program security will have to be built into hardware and be individual specific. To be portable for individuals, you have to have standards," he added.

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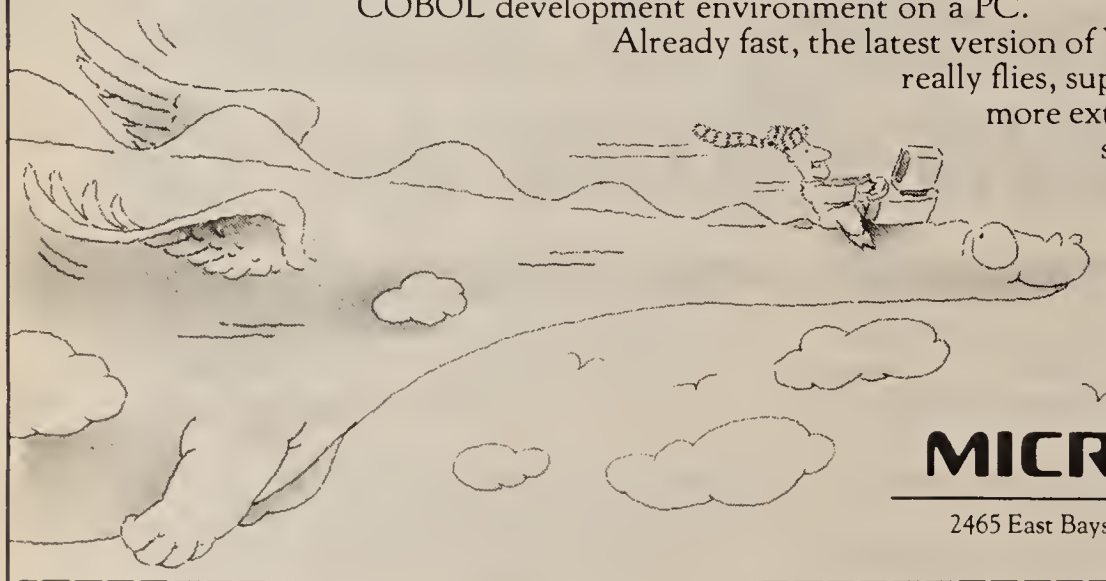

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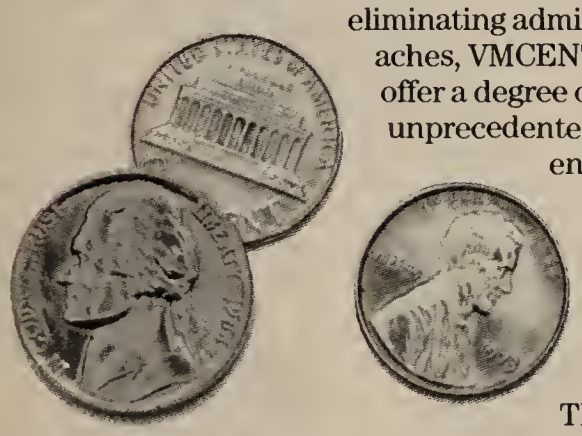

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Ethernet wire option debuts

Astranet scheme runs on IBM Cabling System

By John Dix

MOUNTAIN VIEW, Calif. — Products to implement Ethernet local networks on IBM Cabling Systems with Type 1 or 2 shielded twisted-pair wire were announced last week by Astra Communications, Inc.

Astranet, which can also be used with fiber-optic, under-carpet and air plenum cable, consists of a family of transceivers and concentrators used in conjunction with standard Ethernet host interface units. Used together, they provide an alternative to the large, inflexible coaxial cable typically required with Ethernet.

Astra was formed in December when the team that developed the technology was permitted to leave Xerox Corp.'s Palo Alto, Calif., research center to create the product in return for a Xerox seat on the company's board of directors and a minority stock ownership.

Besides using unconventional media, Astranet differs from standard Ethernet in topology. Astranet is wired in a hierarchical star; nodes are wired star-like into concentrators that, in turn, can be connected to a central concentrator, said Ronald Schmidt, chief technical officer.

When implemented on an IBM Cabling System, Astranet components are used at the workstation and in the wiring closets. Astranet transceivers use a special utility cable to connect to IBM Cabling System wall outlets. Addressed packets are then transmitted to an Astranet concentrator in the wiring closet and are broadcast to all similarly attached devices, looking for the desired node.

"Essentially what we've done is shrink an Ethernet coaxial cable down to a 19-in. printed-circuit board from which we make runs out to nodes," Schmidt said. Concentrators can be expanded to eight six-port models for a total of 48 ports. Up to 32 concentrators can be connected into a central concentrator with fiber-optic cable.

Network nodes can be located more than 100 meters away from concentrators and sometimes farther.

Astranet, which operates at 10M bit/sec. like Ethernet, provides as good or better response time as coaxial-based Ethernet, Schmidt said, "but it probably isn't noticeable."

The network has been alpha tested at Carnegie-Mellon University in Pittsburgh; Texas Instruments, Inc. in Dallas; Micom-Interlan, Inc. in Boxboro, Mass.; and in the Pentagon by the U.S. Department of Defense.

Astranet costs $225 to $450 per node, depending on the configuration and the number of units purchased. It will be available beginning next quarter.

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So

DBMS debate turns bitter

From page 1

IBM's DB2 fared best, conforming to seven rules. But Codd assigned a zero score to Applied Data Research, Inc.'s (ADR) Datacom/DB and Cullinet Software, Inc.'s IDMS/R, saying the two most widely installed independent DBMS had failed to meet fully any of the 12 rules.

Vendor reaction was swift. John Cullinane, chairman of Cullinet, wrote in a letter to *Computerworld* that Codd's piece was "silly," and that adherence to his rules was "analogous to building an airplane . . . that will not fly." Cullinane was referring to Codd's statement that current relational systems cannot handle applications with "extremely severe performance requirements." Responding users sided with both camps. Some backed Codd's plea for relational purity, others embraced Cullinane's call for compromise between theory and the real world.

> ***Some backed Codd's plea for relational purity, others embraced Cullinane's call for compromise between theory and the real world.***

In the days since publication of Codd's articles, *Computerworld* has explored many facets of the relational issue, including the debate over whether the model outlined by Codd is the only valid description of relational technology. "There is only one model," Codd said. "It is recognized as the only one by technical people throughout the field."

Not so, said Cullinet President Robert Goldman. "Is there a final word on what relational is? Not unless you want to say there is. There is certainly one individual who came up with the idea. But any idea is just a starting point. Guglielmo Marconi defined what a radio was going to be, but it has changed considerably since then."

At the core of the controversy is the issue of whether a hierarchical or networked DBMS that has evolved to support relational capabilities can be labeled — and marketed — as a relational DBMS. "Inverted file systems became relational, and there was no controversy, everyone agreed to it," Goldman said. "But the fact that a networked system could become relational, well, that wasn't possible. The major concepts of relational technology, the tabular representation of data, the absence of embedded pointers, the use of Select, Project and Join functions, have been implemented within IDMS/R."

But, Codd said, it is inappropriate to call any DBMS even minimally relational unless it supports at least half the rules. "The first rule is the most important — that information must be represented explicitly by values in tables. Most of these systems that have relational features grafted onto them do not support that rule because they are trying to remain compatible with the past."

The topic of performance permeates the debate over relational systems. Vendors argue that their products do not follow the letter of the relational law because to do so would make the systems inappropriate for most users' needs. "Without embedded pointers, relationships between data are maintained through indexes," Goldman said. "Index processing is simply not as fast as the processing of embedded pointers. With today's hardware technology, a purely relational system cannot handle the most performance-sensitive user requirements."

Codd agreed that current relational systems have performance limitations, but he placed the onus for that problem squarely on vendors. "They keep barking on this performance myth because they haven't put in the necessary research and development to get good performance with the relational approach. Without putting in the effort, they want to announce that it is an impossible problem. It isn't."

Can relational implementations stray from Codd's theoretical foundations? "It is a complete confidence trick on the part of critics to say I am concerned more with theoretical purity than with practicality," Codd said. "They are saying that anything with a theoretical foundation cannot possibly be practical. It is ridiculous for vendors to talk about serving practical needs of users. Some needs can only be served through a decent theoretical foundation."

ADR's Antony Percy, director of product planning and integration and a former data base administrator, said the value of a relational implementation is not dependent solely on its adherence to Codd's rules. "Codd is absolutely correct to clarify what he means by relational. We have embraced the rules as sound and sensible. But with our products, we are trying to address productivity issues that are more important than some of the esoteric rules of data base. That is not to undermine the validity of the rules, but they are just not as important as some of the other problems MIS directors are facing today."

When all the issues are distilled, however, the relational controversy may be viewed as an outgrowth of a basic difference in the approach to user needs.

"I am interested in seeing that users get what they need," Codd said. "One of the most important needs today is the ability of users to interact with data in data bases easily. People ask why the relational model isn't fully implemented. I cannot answer that. There isn't any good answer to that."

"As far as following every single rule," ADR's Percy said, "some of them are fairly esoteric and not all that useful. They would have performance penalties, and users are prepared to code around them or live without them. This is not a binary issue. Some of the implementations out there offer very useful benefits to users."

But Codd has cautionary words for vendors. "I do not expect vendors to adopt every aspect of relational technology in one step. But I want them to be honest about what they have. I am very concerned with the dishonesty on the part of certain vendors, and I intend to see that it stops."

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Georgia agency opens bidding for Medicaid DP system

Current setup blamed for $4 million snafu

By James A. Martin

ATLANTA — The Department of Medical Assistance (DMA) for the state of Georgia will solicit bids in March for a new data processing system, claiming that problems in its current system caused aproximately $4 million in overpayments to Medicaid recipients and does not accommodate new departmental processing needs.

Because of computer snafus, the U.S. Department of Health and Human Services in its computer performance review of the state agency said it would not certify the DMA system for nine months of its fiscal year 1984-85. This means the federal agency will reimburse the state department for computer operating expenses on a 50-50 basis for that period rather than at the regular rate of $75 in federal funds to match the state's $25, a loss to DMA of more than $1 million.

In addition, the state auditor's office said it would not be able to audit the Medicaid program in the state of Georgia for 1984-85 because of computer problems that resulted in missing records.

The department's current DP applications are performed on a time-sharing basis by The Computer Co., a Richmond, Va.-based DP service. The DMA's CICS applications are processed through a Paradyne Corp. Parallel Interface Extender at the DP service's Atlanta office, which acts as a local control unit for tape drives and printers.

> ***'We believed the system would be fully operational from Day 1.'***
>
> — Aaron J. Johnson
> Georgia Department of Medical Assistance

The Computer Co.'s Richmond office operates with IBM 3081 Model K and 3033 mainframes for batch and on-line processing and data entry in Remote Operating System Conversational Operating Environment and TSO environments. The Richmond systems service nationwide health care accounts for seven regional offices of the company. End users at the DMA access recipient claims information and have limited update capabilities on RJE terminals.

The DMA will renew its contract with The Computer Co. on June 30 for a portion of the next fiscal year to ensure a smooth changeover in computer systems, a DMA spokesman said. The state agency signed a five-year contract with the firm worth approximately $5 million each year in June 1984. The contract can be terminated after each year by the state if desired.

The programming errors reportedly began when the DMA converted its DP applications from a state-operated dual processor Sperry Corp. Univac 1182 to the DP service's system in July 1984. "There were some conversion problems stemming from the short amount of time between the contract award and the first date of live processing, with very little time for dual processing or parallel testing," said B. P. Fulmer, the company's director of operations in Atlanta.

Problems with overpayments and delayed payments "happened over a year ago and were associated with our conversion, and you know conversions can be perilous," said Aaron J. Johnson, commissioner for the Georgia DMA. However, he added, "We believed the system would be fully operational from Day 1."

Although the present system is "not problem free," Johnson said most of the earlier snags have been cleared up. Meanwhile, the DMA said it plans to seek bids in March for a new system so that the department can expand its services.

"We want to expand to provide coverage for the 'medically needy,' whose eligibility is determined by having income 33⅓% higher than that of the base recipient," Johnson said. "The present system does not accommodate that population. Initially, we thought we could enhance the system to accommodate the changes we want, but we have determined the best way to make those changes is to go for a new system."

Having the company process that additional data would "constitute a major change in terms of the overall contract," Fulmer explained. "It would require major revisions and rewrites of the existing system. We concur with the state that the most equitable arrangement would be to rebid for a system."

Johnson said the DMA would consider any bids for a system from the firm. "I can't say that we will [bid], and I can't say that we won't," Fulmer said. He added that the company would wait to see the state's bid proposal before deciding what action to take.

The DMA has recovered some of the Medicaid overpayments and said it expects to locate all of them. Meanwhile, Georgia will appeal the Department of Health and Human Services' decision not to reimburse for computer services at the 75:25 rate.

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5 Comprehensive data sublanguage	Yes	No	No
6 View-updating rule	No	No	No
7 High-level insert, update, delete	Yes	No	No
8 Physical data independence	Yes	No	No
9 Logical data independence	Partial	Partial	Partial
10 Integrity independence	No	No	No
11 Distribution independence	Yes	No	No
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Source: Computerworld 10/21/85

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Xerox offers net to serve IBM micro, MS-DOS compatibles

Expands office systems line with workstations, printers, telecopier

By Charles Babcock

NEW YORK — Xerox Corp. officials last week announced they will offer an entry-level local-area network that serves IBM Personal Computers and Microsoft Corp. MS-DOS compatibles over twisted-pair telephone wire.

The Xerox Communications 22 (XC 22) network is a version of AT&T Information Systems' Starlan network and is marketed by Xerox under an agreement reached with AT&T in April, Xerox said.

The XC 22 baseband network transmits data at a rate of 1M bit/sec. over telephone wire. A common configuration would place 10 personal computers on the network at a distance of up to 400 feet, said Robert V. Adams, president of Xerox Systems Group, during a press conference in New York Wednesday.

With an optional device, the network extension unit, up to 11 workstations may be connected to the network. They may be located 800 feet from the extension unit and 600 feet from each other.

Any Xerox 6060 workstation equipped with a hard disk can function as a server on the network, eliminating the need for dedicated hardware to control network schedules, Xerox officials said.

XC 22 will be available at the end of the first quarter and can be installed at a cost of $720 per workstation, Xerox officials said.

XC 22 link to XC 24

Adams said Xerox is committed to producing local-area network products that will allow the XC 22 to connect to the higher speed XC 24 local-area network announced in November. The XC 24 transmits data at a rate of 10M bit/sec.

The XC 24 can connect up to 30 MS-DOS personal computers over a 600-ft coaxial cable and as many as 900 devices with additional cabling and repeaters. The XC 24 can share the same cable as an Ethernet network. Personal computers on a shared cable can be configured via software to be a member of one or both nets, Adams said.

Xerox markets the Xerox Network System (XNS) version of Ethernet, and the addition of a dedicated XNS network server to an XC 24 network will allow XC 24 users to migrate to a full XNS network, Xerox said.

Xerox also said it designed both the XC 22 and XC 24 networks to support all applications intended to run under the MS-DOS 3.1 operating system, making them "software-compatibile" with the IBM Token-Ring and PC Network, Xerox said.

Software compatibility, however, only permits IBM's PC-DOS and MS-DOS software to run on both the IBM and Xerox networks. An MS-DOS disk can be transferred physically from a machine on one network to a machine on the other. But its programs cannot be transferred electronically from one network to the other, according to observers familiar with both offerings.

In other announcements, Xerox said it was continuing to expand its office systems line:

■ It announced two mid-range printers, the 4050 laser printer and the 4020 color ink-jet printer. The 4050 can print up to 50 page/min and was designed for volumes of up to 750,000 page/mo. A typical on-line version of the printer costs $140,500. It is available in selected cities immediately and will be available nationwide in the second quarter.

The 4020 ink-jet printer for personal computer users offers seven colors in 4,000 shades and prints a color graphics page in approximately two minutes. It is targeted at the low end of the engineering/scientific market as well as offices, Xerox officials said. It is compatible with 50 popular business graphics software packages developed for the IBM Personal Computer and compatibles, including Lotus Development Corp.'s 1-2-3 and Symphony, Decision Resources Co.'s Chartmaster and Microsoft's Chart. The end-user version is priced at $1,495 and will be available in April.

■ Xerox introduced a document publishing workstation, using the Xerox 6085 MS-DOS professional computer, to create both text and graphics. It will be available in mid-1986, when prices will be announced.

■ Xerox announced a compact 7010 telecopier for sending and receiving documents. It transmits at the rate of 9.6K bit/sec. but can fall back to speeds of 7.2K bit/sec., 4.8K bit/sec. or 2,400 bit/sec. It is compatible with most newer facsimile machines and is priced at $2,295. It will be available March 3.

■ Xerox announced Version 2 system software for its XPS 700 series, its line of electronic publishing systems that manage the input, composition and printing of documents. It will be made available to existing customers at no charge.

■ Xerox also made available six new or expanded modules in its Viewpoint system and VP series application software. They range in price from $100 to $495.

■ Xerox has added Integrated Financial Management to its business solutions packages to run on the 6085 professional computer, usually in conjunction with a department Digital Equipment Corp. VAX. Through the finance package, information on a company's cash position can be retrieved from the VAX and managed on the 6085.

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Honeywell nixing Multics line

From page 1

The unwelcome news will not come as a complete surprise to the close-knit Multics community. The operating system, which was commercially introduced in 1973, has never garnered significant market share throughout its history, despite the fact that it represents a technical milestone and currently is the only operating system with a U.S. Department of Defense B2 security rating.

At an April 1985 HLSUA board meeting, the company foreshadowed this morning's bad news with the cancellation of a project, code-named Flower, that would have supplied a high-end Multics mainframe. "Canceling the program was totally unexpected," said Ron Wong, HLSUA president and a member of Ford's Multics support staff. During 1984, Honeywell Vice-Chairman Dr. James J. Renier, then president of Honeywell Information Systems, visited users and told them about Honeywell's commitment to Flower.

The cancellation raised the ire of loyal users who had planned continued Multics use. "Any migration to another operating system represents a functional regression," noted one MIS manager who did not want to be identified.

> ***'One has to separate the users' strong technical love for Multics from a hard cold business decision.'***
>
> — Theodore R. Josephs
> Honeywell

This manager and others were not pleased as Honeywell's plans unfolded last summer. Faced with the death of the operating system, users presented the company with three alternatives: build the Flower processor, port Multics to another company's existing 32-bit hardware line or sell Multics to a third party that would supply additional hardware.

Throughout the fall, Honeywell explored the alternatives, according to Theodore R. Josephs, vice-president and general manager of the office marketing systems division at Honeywell. The company could not cost-justify either of the first two options. To make money from the new hardware, the company estimated that Multics would have to generate between $35 million and $50 million dollars each year in a five-year life cycle. "To reach those figures, we estimated that 80% of the revenue would have to come from new business," Josephs told *Computerworld* in a recent interview. Since Multics currently has only 54 customers worldwide Honeywell did not think that the new hardware represented a sound business risk.

The cost of porting the operating system to another line of hardware also represented an expensive proposition. "We would have to do more than just port the operating system to another line of hardware," noted Karl F. Laubascher, director of Multics marketing. "We would have had to make a number of expensive enhancements to attract new customers. For example, we would have had to add links into IBM's Systems Network Architecture environments."

Courted three parties

Although Honeywell courted three third parties, none would accompany it to the altar. Two offers did not progress beyond the cursory stage. A third case reached a stage in which Honeywell was seriously examining how it could transfer Multics technology to the interested party before negotiations broke off.

This morning, Josephs will officially tell the HLSUA board that Honeywell is no longer considering any of the group's alternatives. Consequently, users are left with two options: work with Honeywell to formulate a plan to migrate to the new system or start doing business with other vendors.

Honeywell plans to migrate customers gradually away from Multics and its 36-bit architecture to a 32-bit product line running an operating system that will include Multics features such as dynamic linking. "We will try to give users time to examine their options before they decide what their next step will be," Laubascher noted. The DPS 870M, the current high-end Multics hardware, will be manufactured until 1988, and two additional releases of the operating system, one in 1986, are scheduled.

However, users are very concerned about the cost of migrating to the new system. "Migration brings with it a high cost," Wong said. "A company must sacrifice opportunities to develop new applications or enhance existing applications. Also, there is a tremendous cost just moving applications from one system to another."

Users are also concerned about Honeywell's continued commitment to Multics. The company has pledged to support Multics "throughout the life cycle of the product" but would not pinpoint how long that life cycle would be.

For those users who choose to work with Honeywell, the migration path will begin to become clearer when the new 32-bit system is announced. The processor will not meet the needs of some large users who are already taxing their CPUs. To meet the large users' needs, Laubascher stated that in 1988 the company would add another system capable of

See **HONEYWELL** page 14

Honeywell nixes Multics

From page 13

processing transactions at speeds up to 10 million instructions per second.

Another option, which some users are already taking, is to work with other vendors. Southern Co., an Atlanta utility company, installed a Multics processor approximately four years ago to complement existing IBM and Honeywell hardware.

The system has been primarily used for record management and graphics.

Support not the greatest

Dale Steinmeyer, a manager at Southern's system support department, said that the company has begun to trade in its Multics applications for IBM VM/CMS applications. "In the last few years, IBM's graphics capabilities have been improving," he said. "Also, Honeywell's support has not been the greatest, and we expected that sooner or later the company would withdraw full support."

Multics has suffered through an up-and-down history, and the company had previously considered dropping the operating system. "Whenever we considered dropping the operating system, shipments would increase or the company would decide to try another marketing approach," Josephs said.

Marketing has always been Multics' principal problem. "Multics is the best product that Honeywell has ever had to offer, but the product has been sadly misunderstood in the industry and at the company," one observer stated.

The operating system was the result of a mid-1960s research project cosponsored by MIT, AT&T and General Electric Co. Team members included professionals, who later played key roles at Prime Computer, Inc. and Stratus Computer Co., as well as the designers of AT&T Unix.

Upon its completion in 1969, Multics represented an advanced, technically pure operating system with features such as a relational data base, inherent security and dynamic linking.

As the finishing touches were made to the operating system, GE sold its computer business to Honeywell. Along with Multics came Honeywell's GCOS, another large-system, general-purpose operating system, one that was selling quite well.

Honeywell decided to market Multics to a select number of academic and government agencies where a small but loyal following emerged. Universities were enamored of the technical purity of the system and the product's ability to serve as a front-end processor for Cray Research, Inc. supercomputers. Government agencies were interested in the product's security features that were built into the operating system rather than being layered on top of it, which is typical for most large system operating systems.

The loyal following pressured Honeywell into introducing the product commercially in 1973. Despite its technical elegance, the operating system was never widely accepted in commercial markets. Ford is one of only approximately half a dozen large companies that chose to work with Multics.

A number of factors inhibited broad market acceptance. Multics is expensive. The operating system requires a lot of internal and external memory that pumps up its hefty initial price.

Also, third-party software principally consists of only utilities and languages. Little application software is available, and none of the popular data base management or payroll systems can run under Multics.

Did not pursue third parties

Users charged that Honeywell never actively pursued third parties. Honeywell said that the small user base dulled third-party interest. "We met with a company that had a package written in PL/I," Laubscher said.

"Ninety percent of Multics' code is PL/I, so it should have been a rather simple port. The third party declined to write for Multics and was more interested in our small system line. He looked at the small Multics user base and the 30,000 small system licenses we have, and there was just no way he could justify writing for Multics."

Users added that Honeywell pushed its popular GCOS operating system at the expense of Multics. Honeywell also denied that claim. "Multics hasn't had the marketplace acceptance that many of our users felt it should, but it wasn't because we weren't trying to sell it," Josephs said.

In 1983 at the behest of a few large customers, Honeywell tried to position Multics in the office automation arena. Responsibility for the product was moved from Honeywell's Large Computer Products Division in Phoenix to the Office Management Systems Division in Billerica, Mass.

Flower dries up

A pilot project at Honeywell and one customer's site were set up to determine how well Multics would fit in this market. The project met with mixed results, which was a chief reason for the cancellation of the Flower project.

Josephs, who took control of Multics in January 1985, searched for a niche for the beleaguered operating system. "Multics users are a very diverse group, and we were unable to find a niche for the product," he said. "The markets we examined just did not supply enough volume to justify substantial new investments."

So, Josephs had a decision to make. "One has to separate the users' strong technical love for Multics from a hard cold business decision where one has to make an investment," he said.

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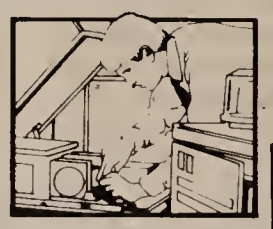

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Honeywell decision puts Groupe Bull in sticky situation

Multics phaseout plan irks European users

By Amiel Kornel
Computerworld News Service

PARIS (CWN) — Honeywell, Inc.'s decision to withdraw gradually support for its Multics operating system has raised the ire of European users and tainted its relationship with French computer maker Groupe Bull, which distributes Honeywell equipment throughout most of Europe.

"Honeywell's decision, and consequently Bull's, is unacceptable," according to Alain Buis, president of the French Multics users group. "We feel a bit abandoned."

More than 35 Multics systems have been installed in France, Great Britain, West Germany and the Netherlands. France, with 26 Multics sites, is by far the largest European market.

Bull sells systems throughout most of Europe, while Honeywell retains marketing responsibility only in the UK and Italy. Once closely linked to Bull, Honeywell is now tied only by distribution and licensing agreements to the state-owned French computer giant.

Angry users are looking to Bull to come up with computing alternatives to Multics in the coming years. "Normally," Buis said, "Honeywell or Bull should supply us with a migration solution offering the same functions as Multics."

The decision to phase out Multics has placed Bull in the cross fire between Honeywell and disappointed clients. A senior Bull official said that the company is entering into discussions with its clients to define solutions appropriate to each site.

But according to a French user who requested anonymity, client reaction to Bull's initial propositions has been tepid. Many clients doubt that current operating systems can offer Multics-like functions.

French users, certainly the largest Multics lobby in Europe, plan to petition Bull at the end of January to define a contractual agreement assuring sufficient technical support for the system into the 1990s.

Bull, replied the company official, is "ready anytime" to sign agreements with the users. Regardless of the outcome of those negotiations, European users, nearly unanimous in their acclaim of the system, will be sorry to see it go.

"The arrival of Multics was a breath of fresh air for computing research," said Georges Nissen, a manager at the Institut National de Recherche en Informatique et Automatique, "but now that air is becoming rarer."

Kornel is Paris hub bureau chief for the Computerworld News Service.

NCR rings up network links

By Charles Babcock

NEW YORK — NCR Corp.'s Office Systems Division last week announced communications products designed to link its personal computers, workstations and Tower minicomputers in a network.

The products, available in March, "allow three different product platforms to operate together," said Robert C. James, vice-president of the NCR Office Systems Division.

At its simplest level, the network consists of software linking NCR Worksaver workstations to each other through asynchronous RS-232 cable connections or telephone lines via modems. Remote file and printer access is provided through two additional software products that run on the Worksaver 300, the Multi-Cluster Interconnect Agent and the Multi-Cluster Interconnect Server.

The maximum data exchange rate with Multi-Cluster Interconnect Level I is 19.2K byte/sec.

At its high-speed level, the WorkSaver Multi-Cluster Interconnect Level II uses Ethernet modules at each master workstation as a network controller for each cluster. The modules provide access to a coaxial cable network supporting up to 64 nodes.

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Additional software, the Personal Computer Connect Package, is needed to allow an IBM-compatible NCR PC4, PC6 or PC8 personal computer to be connected to the Tower server.

Prices on the communications products in Level I are as follows: Level I direct connection asynchronous software, $695 per unit; workstation-to-workstation cable, $100. For remote connection, a $675 modem should be added.

In Level II, the Ethernet Controller Module costs $2,395; the transceiver, $495; and Ethernet 1, $695.

For Level II networks requiring servers, the Tower XP server is priced at $16,445; Towernet, $995; transceiver, $495; transceiver cable, $850; Ethernet adapter, $2,095; utilities, $200; and network terminal, $100.

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VIEWPOINT

EDITORIAL

Vendor follies, user foibles

Today's data processing manager, we like to think, is always a manager first and a DP devotee second. But this week's story on the reactions of users to Honeywell, Inc.'s axing of its Multics operating system seems to prove otherwise.

The story is a common one: a vendor announces that it intends to drop a product line that it claims is unprofitable; feeling betrayed, irate users contend that the product *could* make money but failed largely because it was never marketed properly.

Honeywell may, indeed, have made mistake after mistake in its handling of the technically sophisticated Multics operating system, as its fans contend. What, however, of those managers of Multics shops who watched while the product line stumbled along and who took no steps to migrate to other, more successful systems?

Enamored with the technical elegance of Multics and its unquestionable advantages for some applications, they may have lost sight of their primary charge as managers: to anticipate problems, to plan for change, to evaluate constantly the viability of products and suppliers.

That stance harks back to earlier days of data processing professionals as technicians only. It is a stance that MIS managers and their organizations can ill afford.

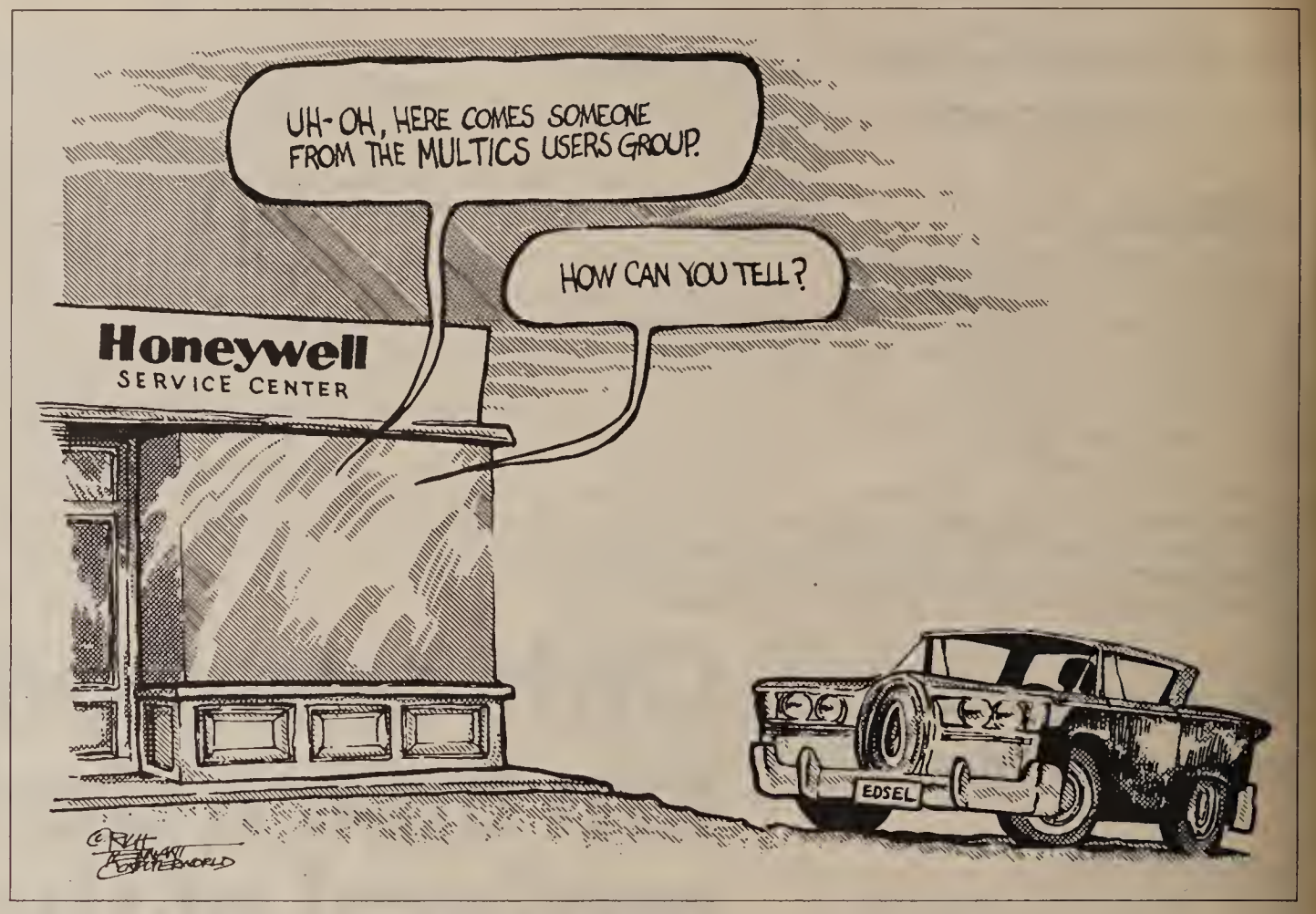
New this issue

The first issue of *Computerworld* to carry, exclusively, a 1986 folio appropriately inaugurates several new elements designed to improve both the quality of the information that we provide to our readers and the way in which we provide it.

The most important of these changes is also the least visible: Beginning with this issue, *Computerworld*'s final news deadlines are midday on the Friday prior to delivery — a full 24 hours *later* than previously. We will provide more timely news than ever before without affecting the delivery of each week's edition of *Computerworld*. In fact, the new arrangement will mean that many readers will now receive their copies earlier than before.

This issue also inaugurates a new feature section, "Executive Report," that will appear three weeks out of every four. The section will focus on key topics of the moment (this week's: expert systems) and recommended computer management strategy in dealing with them. Alternating with "Executive Report," one week out of every four, will be an expanded "Product Spotlight" section, in which we will present comprehensive coverage of new technologies, purchasing standards and vendor offerings within important product categories. The first "Product Spotlight," dealing with manufacturing resource planning software, will appear in the issue of Jan. 27.

Finally, this issue finds the "Computer Industry" section — typically, according to reader surveys, our best-read news section — beginning on the page facing the inside back cover. The move will both increase the prominence and accessibility of this popular section and allow us to cover breaking computer industry news right up to our latest deadlines.



LETTERS TO THE EDITOR

IBM executive Berland challenged on site licensing, quality, pricing

In the article "IBM Information Services' Berland refutes critics' charges" [CW, Dec. 9], IBM's Robert Berland, director of Strategic Planning for IBM Information Services, stated that site licensing, where a company pays one fee to use as many software copies as it needs, is wrong because it leads to illegal copying and erosion of the software's asset value. Berland further stated that a volume discount structure provides superior asset value protection. These generalities are inaccurate.

A site license is analagous to an "all-you-can-eat" smorgasbord. Not knowing precisely how much food a patron will eat does not prevent the restaurant owner from setting a price. This is because the owner can reasonably estimate the maximum amount of food and drink a person is likely to consume and prevents patrons from taking lobster tails home in their pockets.

Albeit a rough analogy, IBM's pricing challenge is no tougher than that confronting Bob and Betty's Eatery. The number of software copies likely to be made at any site will bear a predictable relationship to certain identifiable characteristics of the site.

Further, it is always possible for the licensor to set some maximum use limitation to avoid abuse. This assumes that copying is limited to the company's internal use, an assumption that draws into the question the second objective of asset protection, namely, the protection of copyrights and trade secrets.

To be sure, the periodic purchase orders issued under a volume discount license serve to identify the number and identity of software copies a company possesses, assuming each such copy is copy-protected.

Although helpful, such a record by itself will not stop misuse and theft of such copies. A properly drafted license agreement, volume discount or site license variety imposes full responsibility and liability upon the company for misuse and theft of software copies. It is this potential liability, and not a record of purchase orders and software serial numbers, that induces a company to prevent theft and misuse of a vendor's software.

Although it would be encouraging if IBM would voluntarily embrace and promote site licensing, the opportunities available to a vendor willing to bring its licensing practices back in touch with market realities will ultimately prove too profitable for software vendors, including Big Blue, to resist.

Michael Brownell
Berman, Roberts & Kelly
Chicago

■

I was extremely disturbed by the responses of IBM's Robert Berland to questions posed to him in the *Computerworld* article "IBM Information Services' Berland refutes critics' charges" [CW, Dec. 9].

His responses, which, by the way, are not typical of IBM executives, seemed to indicate a considerable apathy toward IBM's software customers and their concerns, particularly in the area of pricing and quality.

For example, to the question of unwarranted and frequent price hikes, Berland's response, "If more customers would buy these products, it would help us all relative to pricing," was a cop-out. Maybe if prices were lower and the quality were more in line with competition, more people would buy the product.

How about his answers to the questions of IBM being faulted for not offering products of as high quality as the competition's? To quote Berland: "You can't expect us to write the best package in the world in an area where we don't have expertise." Well, if you don't have the expertise, why write the package?

Also, this is IBM, not some garage shop. Isn't IBM supposed to have high standards?

Then there was Berland's answer, "Site licensing . . . is wrong because you have no asset protection." What about the other side of the issue — the customer's needs? Volume discounting does not address the entire issue of why site licensing is needed or warranted.

Throughout the interview, there were numerous examples of a complete lack of sympathy for IBM's software users. As far as I am concerned, it's OK with me if Berland wants to hide behind the big blue walls of IBM, to ignore the facts and to blame everything on the customer. I'll just get my software elsewhere.

Sonney M. Taragin
Vice President
Global Computer Services, Ltd.
Glen Burnie, Md.

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   - 65. Public Utility/Communications Systems/Transportation
   - 70. Mining/Construction/Petroleum/ Refining/Agriculture
   - 80. Manufacturer of Computers, Computer-Related Systems or Peripherals
   - 85. Computer Service Bureau/ Software/Planning/Consulting
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   - B. Minicomputers/Small Business Computers
   - C. Microcomputers/Desktops
   - D. Communications Systems
   - E. Office Automation Systems

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VIEWPOINT

Bargain hunting for micros: a risky business

By Amy Wohl

WOHL STREET MINIJOURNAL

There are dazzling savings to be had in personal computers these days. Basically, you can go into nearly any computer store that deals in "other IBM compatibles" — other than those from Compaq Computer Corp., that is — and find some IBM compatible in nearly any configuration for about half the IBM price.

If you're not as fussy, you can probably find a "no-name" IBM compatible for even less. These products are often offered through back-of-the-magazine ads, direct mail fliers or word of mouth. They are backed up by warehouse-plus-telephone operations; there is no display floor or sales representative in a pin-striped suit. There is no support beyond the manufacturer's warranty and some kind of board-component swap policy, if the discounter stays in business.

Sound risky? It could be. But for some personal computer users, the discounted prices of second-, third- and nth-tier products are so tempting they're buying in spite of the risk.

Recently, we spoke to a savvy personal computer user who is equipping his small company with a number of no-name IBM-compatible microcomputers and a local-area network to tie them all together. He said at the prices his company is paying, it's looking at the $1,000 to $1,500 microcomputers as throwaways.

This set us to thinking. When is it a good idea to take advantage of heavily discounted me-too products and when is it a good idea to pay a premium price for the real thing?

Some things seem obvious. The best time to take advantage of the discounted copy is when the original is near the end of its technology cycle — a mature product, full of useful life, with all kinds of third-party products and services surrounding it — but overpriced relative to copycats.

The fact that a new product, perhaps a radically different one, might soon be coming into the market is another reason to buy the copy. Why pay premium prices when the useful life period of the product you're buying today could be unpredictably shortened by a new product that is announced tomorrow?

Considering potential problems

You might ask, Why buy at all? Why not wait until the new product is announced and buy it? You might consider these potential problems:

- The new product might have a long lead period between announcement and first delivery.
- The new product might not be available in quantity.
- The new product may need to live through a shakeout period before its initial flaws are removed.
- Third-party products and services to support the new product may take months — sometimes years — to emerge.

When talking about a personal computer, the hardware is only useful if the needed software is available, running smoothly and adequately supported. A radical product change, like the market's move away from Apple Computer, Inc.'s Apple II and toward IBM's Personal Computer in mid-1981, can require a wait of a year or more before adequate quantities of software will be available for the product.

So you may need to choose based on what's available today, rather than on what may be coming soon. But why pay more than what is required?

For the knowledgeable user, taking advantage of second-tier and lower substantially discounted products can make sense:

- If you understand that newer technology is coming and are either willing to continue using the older technology for a reasonable period of time or agree that the discounted price is inexpensive enough to discard the old technology when the new technology is available.
- If the buyer requires very little support or the discounted product is purchased from a reputable local source who provides support. A note of caution: You must be prepared to pay enough so that the seller can make a reasonable profit on hardware or support or both.

Also, if the product manufacturer goes out of business, it may eventually become impossible for the seller to provide adequate service. The larger the installed base of product that already exists, the better the chance that third-party vendors will provide parts and service forever.

Buy security and insurance

On the other hand, there are some cases in which we would absolutely recommend that you steer clear of those tempting discounted prices and buy some security and insurance. Special caution is called for in the following situations:

- This is your company's first personal computer. You'll need more help than sharply discounted pricing can afford.
- You're counting on lots of support for training, application development or software selection. You need to buy in an environment that can afford to support you.
- You're in a remote location. Even if there is one nearby source of repairs, what will you do if they decide to discontinue support?
- You're in a conservative company that expects its suppliers to be around forever.
- Your company requires long write-off periods for any physical equipment. Wait for the next generation if you can. Try to rent or lease equipment. Have a plan for giving the equipment to a lower level user in your organization when you're ready to upgrade if you can't wait and you know you'll need to trade soon after the next generation of the product is announced.

The point is that personal computer technology has gotten much less expensive. You can take advantage of this bounty, but you should be sure that you understand what you are, and are not, getting for your dollars.

Wohl is president of Wohl Associates in Bala-Cynwyd, Pa., and editor of "The Wohl Report on End-User Computing" newsletter.

The politics of software

By Robert Sherin

READER'S PLATFORM

Software, the Geneva Summit and "star wars": What do they all have in common?

Surprisingly, the once-unrecognized stepchild of hardware, software has become a basic player with awesome potential in the international arena. In Geneva, Soviet warmth was no accident. Although we all need a hasty end to the arms race, they need our technology.

To a bureacracy built on secrecy, management information systems are an anathema — no matter how much the Soviet Union can benefit from them. Mikhail Gorbachev's concern is reflected in speech after speech, in which he calls technology the "task of paramount political, social and economic importance."

So he went to Geneva with hat in hand ready for compromise. High on Gorbachev's agenda, besides arms control, was Western technology. That, of course, includes software.

Software has always stood center stage, though unheralded and treated as a distant relative by our government. As far back as 1969 when IBM unbundled software from hardware, the industry started debating its own identity.

Having grown from the experience, leading software companies now market themselves as the great equalizers. The question facing the the U.S. as Congress looks askance, laboriously debating President Reagan's tax plan for the redistribution of the nation's dwindling wealth, is how to create new wealth.

They see us more clearly from overseas. According to Jean-Jacques Servan-Schreiber, former president of the Centre Mondial de Resource Informatique, a research center for microcomputing and artificial intelligence based in Paris, "Today the U.S. needs another kind of new deal, a new deal that will employ U.S. citizens to build the new infrastructure of the computer age.

"Computer literacy must be the priority. Because the U.S. and Europe cannot compete with cheaper labor of the Third World, we can prosper only by reordering our priorities so as to develop fully our human and intellectual resources," Servan-Schreiber said.

France is on the leading edge of a growing movement of governments, the U.S. being the most notable exception, which see their futures inexorably tied to high tech and are taking decisive steps in that direction. Although Japan, the most striking example, made no secret of its sweeping plan to shift from smokestack industrialization to high technology as far back as 1972, the U.S. paid little attention, confident in age-old industrial policies.

Now in our jealousy over Japan's success, much of the U.S. cannot bring itself to face the music. Instead, today's protectionism, reminiscent of the Smoot-Hawley legislation of the 1930s that brought world trade to a trickle, has gained unparalleled respectability. At a time when Japanese enhancements to U.S. semiconductor technology have resulted in new efficiencies in software through reduced memory pricing, powerful forces in the U.S. are trying to slow Japanese advances.

Computer people, however, are attempting to attack the problem in realistic terms. Although the Data Processing Management Association has been wrestling with high-tech policy deliberations since 1980, for the second consecutive year the Association of Data Processing Service Organizations, Inc. (ADAPSO) spotlighted the need for a national high-tech policy for the U.S. at its annual convention.

Far removed from the fractious infighting in the 1970s for favored government treatment among software manufacturers and users and professional services, ADAPSO has come of age in its concern for the national interest.

In October, Rep. Ed Zschau (R-Calif.) laid the predicament of the U.S. on the line. He said, "We need more people from business in government. We need people who understand where jobs come from and what it takes to create economic growth. If everyone with something more important to do doesn't get involved in government, we're left with the leadership of those who have nothing more important to do — and that's a real tragedy to a country like ours." Zschau is a former Silicon Valley businessman.

After all the rhetoric, the U.S. has a twofold role: To negotiate a durable peace with the Soviet Union and to manage the transition from the industrial age to the information age with fairness and efficiency.

Sherin is president of Southern Computing Services, Inc. in Miami.

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COMMUNICATIONS

WIRE TAP
Daniel Minoli

ISDN bodes improvements

FIRST OF TWO PARTS

Series 3000 voice-grade private lines have been the staple of the communications industry for several decades. They are, however, limited in their ability to carry data because they are analog and designed for voice. The Integrated Services Digital Network (ISDN) promises an attractive alternative to these leased facilities.

ISDN, which is going into test mode this year, will provide substantial improvements for transmission of data. In this column and the next, we wish to acquaint the data communications manager with the promises of ISDN.

Today the majority of off-premises data transmission is handled by analog facilities. An analog system transmits information by emitting continuously varying signals. To transmit digital data over analog facilities, the data must first be transformed into an analog signal, a feat accomplished at a cost with a set of modems.

That is only the first of many likely transformations the signal will undergo before reaching its final destination.

For example, a digital signal translated by a modem to an analog format may have to be retranslated into a digital signal if the particular local telephone company circuit or loop it is

See **ISDN** page 22

Minoli is a member of the Bell Communications Research (Bellcore) network architecture planning group. Opinions in this column are strictly the author's and do not represent the view of Bellcore.

NATA critical of FCC, Bell

Report charges Centrex revival as serious threat

By Bryan Wilkins

DALLAS — The North American Telecommunications Association (NATA) charged that the "unbridled promotion" of Centrex services by the divested Bell operating companies will ultimately cause a crippling effect on the independent telephone equipment industry.

In a report released at its annual convention, NATA said the Centrex revival is a result of "artificial promotion" by the public policies of regulators, principally the Federal Communications Commission.

NATA said the Centrex service, based in a telephone company's central office switch as opposed to the customer's office, allows users to avoid federal access charges at the level equivalent to other business lines and has been upgraded with features that render it an enhanced service rather than a basic telephone line.

The report said Centrex line installations will increase 4.4% per year between 1983 and 1986, resulting in a net loss of more than two million equivalent private branch exchange lines.

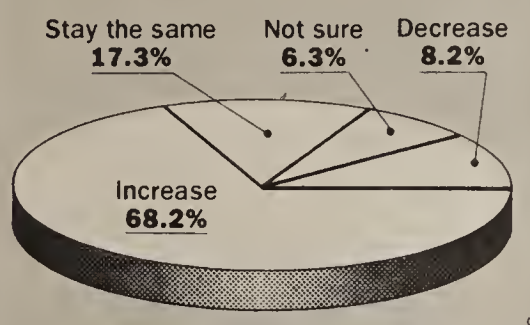
The NATA report also said that the area of greatest growth for Centrex was occurring in small line sizes. For installations with less than 100 lines, growth in Centrex has been greater than 50% per year.

In another development, NATA charged that the FCC is allowing the seven regional holding companies and their 22 divested Bell operating companies to fund their competitive equipment sales ventures from regulated local-service revenues.

NATA asked that the commission reconsider its recent waiver of the Second Computer Inquiry. The waiver permitted four of the seven holding companies to combine equipment sales forces with network service forces. A policy that separates regulated from unregulated operations is currently under FCC review.

DATA VIEW

More money for data communications



110 respondents

Source: International Data Corp.

Most data communications budgets will get a cash infusion in 1986, according to a recent survey. The results reflect a mixed story of growth, tight purse strings and savings made possible through new technology.

U.S. view sparks Intelsat dispute

By Bryan Wilkins

WASHINGTON, D.C. — A nasty dispute that has taken on the tones of a family feud is threatening years of goodwill in the International Telecommunications Satellite Organization (Intelsat). The aggrieved party is none other than the U.S. government, which was largely responsible for the 1962 formation of the now 110-member consortium.

ANALYSIS

At issue is the recent change in U.S. government policy permitting private sector competition to enter Intelsat's monopoly market for international satellite services. To date, five U.S. firms have signaled their intentions and have received preliminary Federal Communications Commission ap-

See **U.S.** page 22

NEW THIS WEEK

- NCR offers its Remote series micro-to-mainframe links
- For more on this and other new products, see pp. 77-94.

INSTANT ANALYSIS

"Fiber-optic systems that the industry put in place during the past year set the scene for very significant differences in the capabilities of the phone systems we all have."

— Bob Harcharik, president of MCI Digital Information Services Co.

Department of Defense fights for own uniform standards

Pending ISO design will not meet needs

FIRST OF TWO PARTS

By William Stallings
Special to CW‡

The U.S. Department of Defense determined that its major data processing needs are best met by a strategy of distributed data processing and computer networking. The following are two key elements of that strategy:

- Interoperability. Devices from multiple vendors must be able to communicate. For this purpose, the DOD issued a set of military standards for communications protocols.
- Long-haul networking. To minimize long-haul communications costs and increase security, the DOD developed the Defense Data Network (DDN) and issued interface standards for attaching components to the network.

This article examines the DOD protocol standards. Next week's article will examine the DDN.

The DOD recently promulgated standards for a set of communications protocols. Its motivations are much the same as those of any computer system customer. The DOD needs to have efficient, cost-effective communications among computer systems from various vendors. To achieve this communications compatibility, the DOD asked supplying vendors to conform to a common set of protocols.

The International Standards Organization (ISO) has also been active in this area. It defined a communications architecture — or framework for protocol standardization — and it is in the process of developing protocol standards within that framework.

There is every sign that the ISO standards will enjoy widespread acceptance. Despite this expectation, the DOD defined its own architecture and developed its own protocol standards. There are two reasons for this decision:

- DOD-specific requirements, such as security and robustness, have a major impact on the design of protocols and network architectures. These concerns have not been uppermost in the minds of the ISO developers and, predictably, are not well reflected in its net model.
- The DOD protocols were specified and extensively used prior to ISO standardization of other protocols. Because the DOD's need was immediate, it felt it impractical to wait for the ISO protocols to evolve and stabilize.

The DOD architecture is based on a view of communications comprising processes, hosts and networks. Processes are the fundamental entities that communicate. Processes execute on hosts, which can often support multiple simultaneous processes.

See **DEFENSE** page 23

Stallings is president of Comp/Comm Consulting of Great Falls, Va., and the author of Data and Computer Communications. *He will conduct a short course on the Defense Department Network and U.S. Department of Defense protocol standards for the University of Maryland Conferences and Institutes Programs on June 4-6.*

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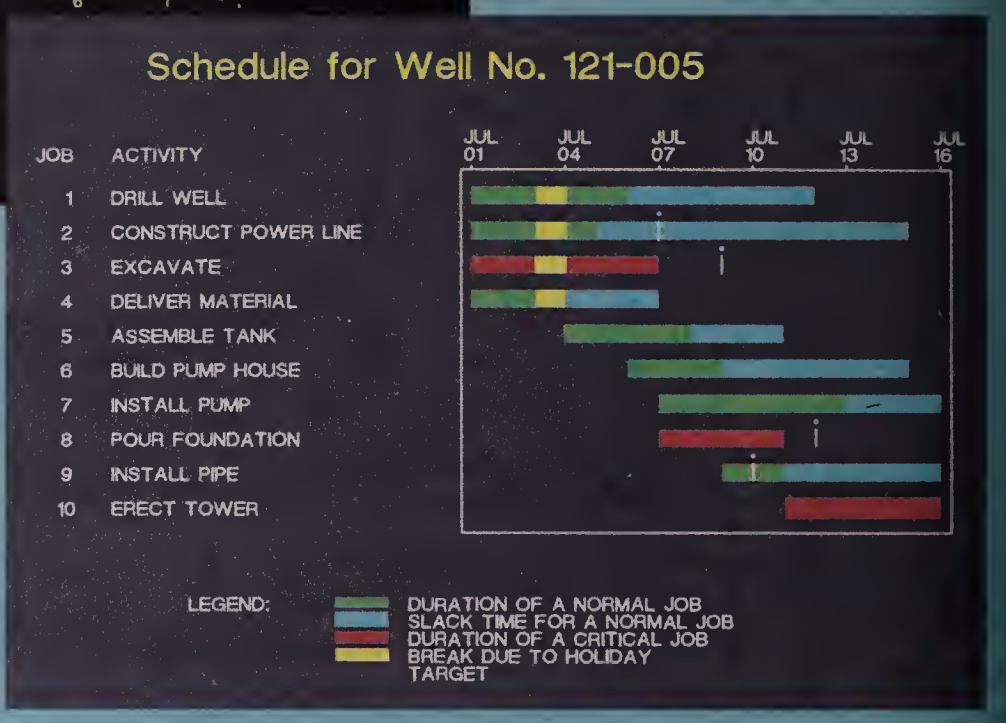

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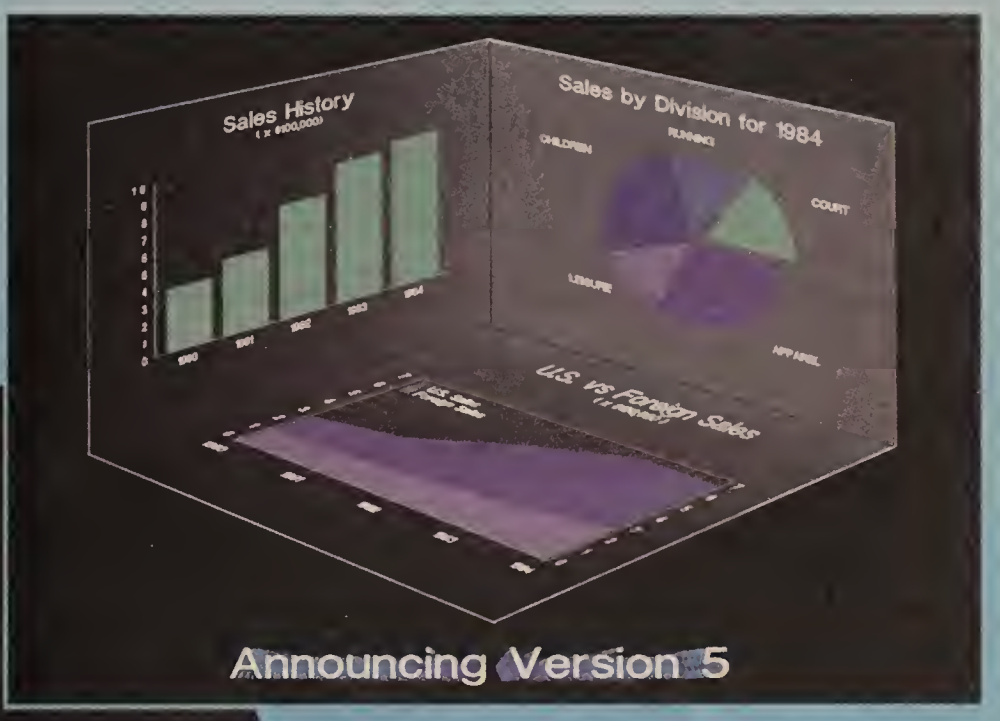

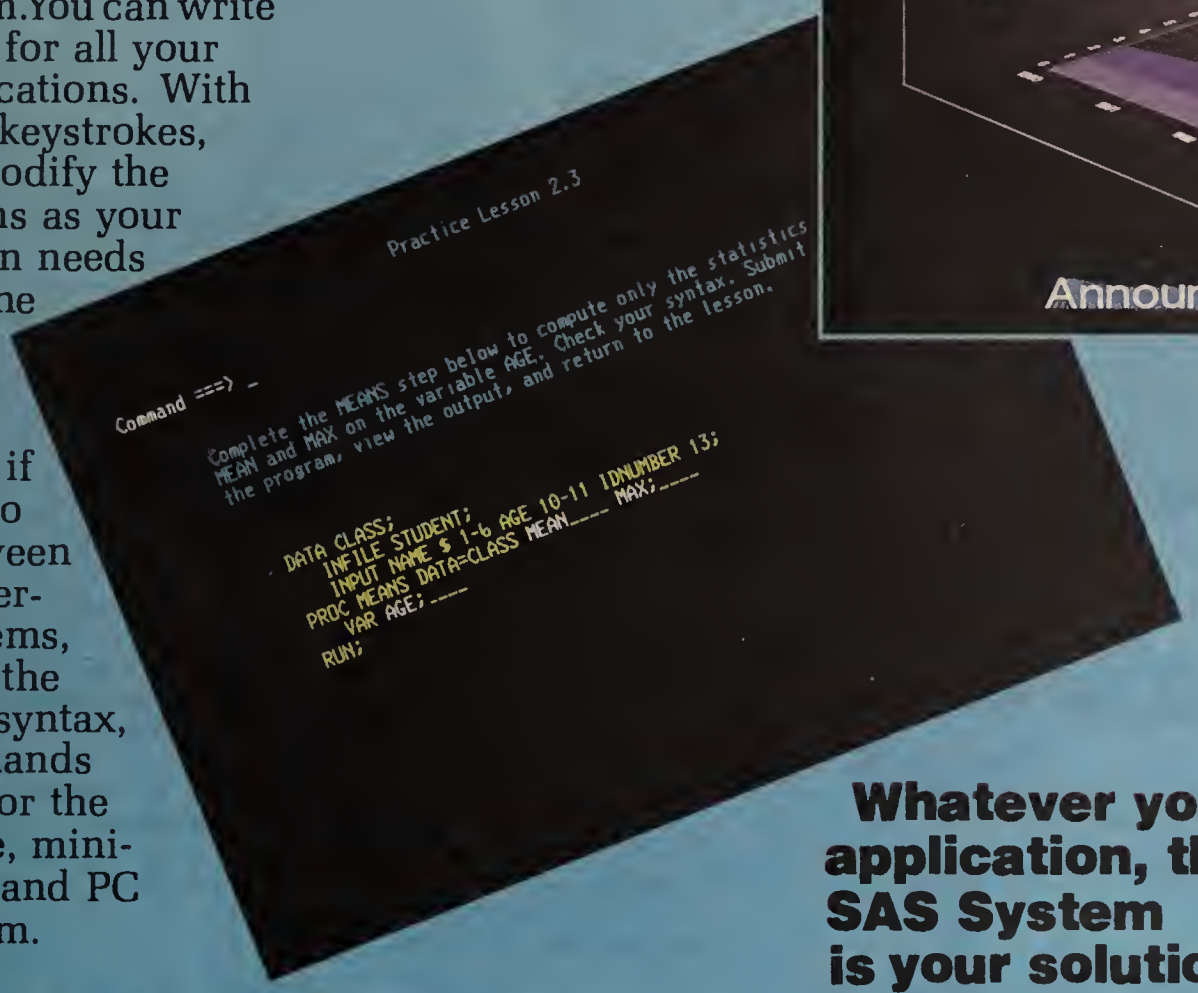

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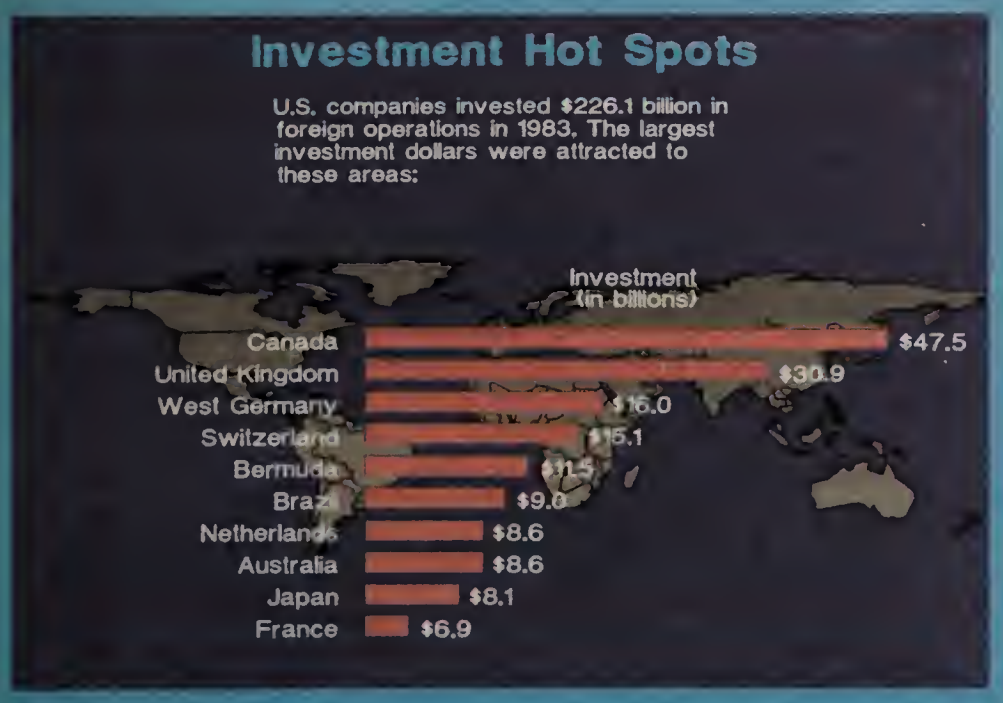

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ISDN bodes improvements

From page 19

connected to is a carrier system.

If we are talking about a dial-up connection and if the telephone company central office switch at the other end of the circuit is an old type, the information will be translated once again into an analog format to be switched.

As the information leaves the switch, it may be redigitized for a short-haul fiber-optics system, then switched through a newer digital switch, then retranslated to analog format to be placed on an L5 coaxial or analog microwave long-haul system and so on down the line until the signal reaches its destination.

In the process, noise, cross talk, attenuation, distortion and other factors affect the signal. This, in turn, affects the bit error-rate and with it the effective throughput and the user-experienced response time.

Using Nyquist's and Shannon's equations, we are able to show that the maximum conceivable throughput on a Series 3000 line will be around 25K bit/sec. Until a few years ago the problems listed above limited the practical data communications speed for such facilities to 4.8K bit/sec. Improvements in modem signal processing technology have raised the standard to 9.6K bit/sec.

Modems introduced in the past couple of years are capable of transmitting at 14.4K bit/sec. or even 19.2K bit/sec. for short distances, but users normally find that they have to step back to the "safe" 9.6K bit/sec. mark because of the noise characteristics of private lines. This capacity limitation makes the Series 3000 ill suited for such applications as file transfers, local-area networks for on-premises distribution, video transmission and graphics.

The existing system used to provide Series 3000 private lines is optimized for voice. As such, frequency response, call setup time, throughput, error treatment and use of echo suppressors are geared for voice rather than data. In a system designed for data, echo suppressors will not be present, throughput will be much larger to accommodate for bursts of traffic, call setup time will be shorter, and the protocol will be quite different.

Furthermore, data networks will contain error correction mechanisms such as forward error correction or the ability to request retransmissions. Finally, such networks will be totally transparent; when constructing networks, users will not have to compensate for technologies, such as time-assigned speech interpolation, used in analog systems.

ISDN is the next step in the evolution of the telephone system, and contrary to previous enhancements — such as digital switching and digital multiplexing that have been transparent to the end user — ISDN promises to have high user visibility. The end user, particularly the data communications user, will see substantially more bandwidth becoming available.

ISDN provides end-to-end digital connectivity, which in turn affords improved economics and performance. It will be an integrated service where the customer may be able to select from a menu of options, enhancing the flexibility of the communication pipe.

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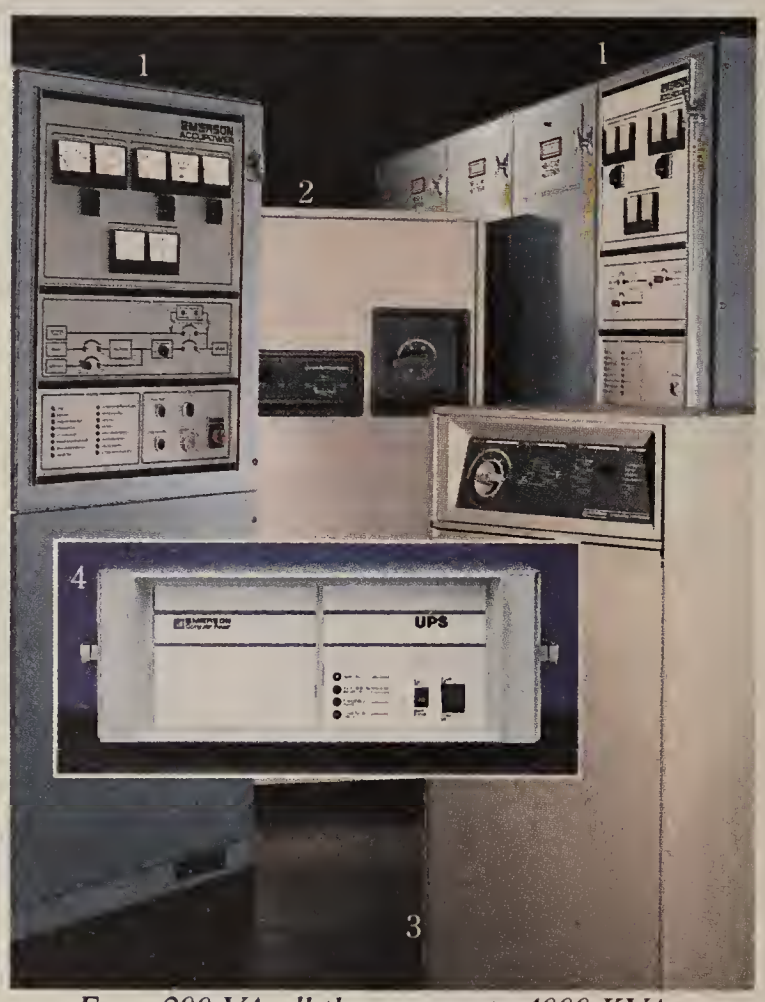

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U.S. view sparks Intelsat dispute

From page 19

proval to serve the North Atlantic market, which accounts for the majority of Intelsat business revenue.

Intelsat, led by Director General Richard Colino, charges that the competition will be "cream skimming," but he has fought back by making unused transponder capacity available to domestic users at prices and for periods of time that are said to be extremely attractive. This pricing is the source of contention between the U.S. and Intelsat.

Rodney Joyce, acting assistant secretary of commerce for national telecommunications, said U.S. policy favors "anyone who wants to compete in the market segment served by Intelsat." However, Joyce said, "the U.S. has serious questions whether the Intelsat rates are cost-justified."

Joyce's concern is apparently catching on in other Washington offices like the U.S. Congress, where Colino's abrasive dismissal of the U.S. government's concerns have not gone over well, especially since the U.S. pays roughly one quarter of Intelsat's expenses. One top-level congressional aide on the U.S. House of Representatives Foreign Affairs Committee said, "Colino has not helped Intelsat's cause up here at all. He has hurt it."

For its part, Intelsat has firmly asserted that the prices it is setting for its transponder sales and lease program, which affect 190 available Intelsat transponders, "are equal to or greater than the prices that would be necessary to recover a full allocation of Intelsat's net book value for costs incurred as well as future program and operating costs." Intelsat said the program will generate $150 million in additional revenues.

The change in U.S. policy to consider satellite transponder capacity as a commodity, where pricing is determined by open market forces and competition, mirrors earlier FCC and congressional policy disputes over the course of the domestic U.S. telecommunications industry, which preceded the breakup of AT&T.

Defense fights for standards

From page 19

Communication between processes takes place across nets to which hosts are attached.

These three concepts yield a fundamental principle of the architecture. The transfer of data to a process can be accomplished by first getting it to the host where the process resides and then getting it to the process within the host. These two levels of demultiplexing can be handled independently; therefore, a network need only be concerned with routing data between hosts, so long as the hosts agree on how to direct data to processes.

Four protocol layers

Using these concepts, it is natural to organize protocols into four layers: the network-access layer, the internet layer, the host-host layer and the process-application layer.

The network-access layer contains the protocols that provide access to a communications network. Protocols at this layer are between a communications node and an attached host or its logical equivalent.

A network layer entity is invoked typically by an entity in either the internet or host-host layer, but it may be invoked by a process-application layer entity. Standards at this layer are needed to attach to DDN.

The internet layer consists of the procedures required to allow data to traverse multiple networks between hosts. Thus it must provide a routing function. This protocol is usually implemented within hosts and gateways. A gateway is a processor connecting two networks whose primary function is to relay data between networks using an internetwork protocol.

The host-host layer contains protocol entities with the ability to deliver data between two processes on different host computers. A protocol entity at this level may (or may not) provide a logical connection between higher level entities.

The process-application layer contains protocols for resource sharing, that is, computer to computer, and protocols for remote access, that is, terminal to computer.

DOD-issued protocol standards include the following:

■ The Internet Protocol. This calls for a means to connect hosts across multiple networks. Its most common use within DOD will be to interconnect DDN with local networks at various sites.

■ The Transmission Control Protocol. This will provide a reliable end-to-end data transport service.

■ The File Transfer Protocol. This will send files from one system to another under user command. Both text and binary files will be accommodated, and the protocol provides features for controlling user access.

■ The Simple Mail Transfer Protocol. This is a simple electronic mail facility.

■ Telenet. A terminal-handling program, GTE Telenet Communications Corp.'s Telenet was designed primarily to handle simple asynchronous terminals but will also support synchronous terminal traffic.

DOD is in the process of achieving its interoperability objectives. DOD has also expressed its intention of ultimately changing from its own military standards to international standards developed by ISO and Consultative Committee on International Telephony and Telegraphy. Until that time, most vendors will have to support both sets of standards, a fact other users can capitalize on.

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2. BAD DOCUMENTATION LEADS TO COSTLY MAINTENANCE: Even if the documentation started out being accurate, it's probably never been updated. When modifications occur, someone's got to go back and attempt to divine the underlying logic before new code can be inserted. A long and costly operation.

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SOFTWARE & SERVICES

SOFTALK
Pieter R. Mimno

Changes favor end-user access

The ability of business professionals to access and manipulate computerized information is essential to the management of any organization. Managers have long recognized that computerized information is a primary corporate resource that must be utilized effectively to meet strategic corporate objectives.

Until recently, it was difficult for both business and DP professionals to access and manipulate data. Top executives and managers often had to wait weeks for an overloaded DP staff to respond to requests for information from the data base. DP professionals also have been severely limited in their ability to respond to requests for information or services due to their reliance on inefficient, hand-crafted programming techniques. The manually oriented coding techniques used by most DP professionals are inadequate to meet the rapidly rising demand for access to information and for new computer applications.

Fortunately, major changes that radically simplify the interface between computers and all categories of users are now occurring. These changes represent a fundamental shift away from inefficient, DP-oriented information processing techniques and toward highly automated, end-user-driven techniques.

Advances in hardware and software technology enable information to be made available to executives, managers and operational personnel without direct support of information services. These advances include major improve-

See **CHANGES** page 32

Mimno is an independent consultant and editor of "The James Martin Report on High Productivity Languages," *a Marblehead, Mass.-based information service that provides continuously updated information on high-productivity tools.*

Antitrust agency develops litigation tracking system

By Mitch Betts

WASHINGTON, D.C. — The Antitrust Division of the U.S. Department of Justice has developed what it said is the most comprehensive litigation tracking system in the government and now faces the challenge of weaning users away from their personal index card files to the on-line data base.

The new Antitrust Management Information System not only tracks the progress of investigations and court cases but also monitors staffing, personnel costs and other expenses, tracks court judgments and sentences, provides statistics for department economists and acts as a project accounting system, according to Dan Schwartz, chief of MIS.

Consequently, it can be used by senior management for budget reviews, personnel work load reports and economic studies and for answering congressional inquiries, Schwartz said in a recent interview. To assist other divisions and agencies, the system also tracks cases that have been appealed, he added. Users include about 330 lawyers and legal assistants, about 80 economists and some 70 managers in the Antitrust Division.

In the past, lawyers kept track of their cases on index cards because the old batch-oriented tracking system was notoriously inaccurate and outdated. So when it came time to design a new system, "users realized we had a dog of a system and were willing to help us," according to Eugene Newman, senior systems analyst.

Because the users enter the data, it tends to be more accurate, Newman said. "We now put the onus on them to update and maintain their data," he said. "Our goal is to get rid of all those card files."

The new system was built on Cullinet Software, Inc.'s IDMS/R data base management system, running on an IBM 3033 mainframe at Computer Network Corp., a time-sharing facility in Washington, D.C. Users access the data base via Wang Laboratories, Inc. VS 100 workstations (with

See **ON-LINE** page 31

SOFTWARE NOTES

Focus language for VAX upgraded

Information Builders, Inc. recently released the first production version of its **Focus** fourth-generation language for **Digital Equipment Corp.** VAX processors. **Production Release Version 1** was an upgrade to the **Early Release** version announced in June. Production version enhancements allow users to read and relationally join DEC **RMS files** and **RMS sequential files** and support concurrent updating of the Focus data base by up to 256 simultaneous users. Also, a **Host Language Interface facility** enables programs written in DEC VMS-compatible languages to access and maintain Focus data bases.

■

Inference Corp. and the **National Aeronautics and Space Administration** have agreed to develop jointly a

See **NOTES** page 31

Eden monitors Cobol systems

By Eddy Goldberg

CARMEL, Ind. — A software package that makes it possible to test the quality of a Cobol program has been released by Eden Systems Corp.

According to President Richard P. Nashleanas, Q/Auditor is a software engineering tool, expressly designed for quality assurance, that evaluates the degree to which Cobol programs comply with standards the user has set.

The product can also be used to assure that the quality of existing Cobol programs is not degraded by maintenance.

Q/Auditor includes nearly 200 different measurement standards that users can select in any combination. Each standard features a five-level grading system that users also define.

Q/Auditor runs on any system that has a Cobol compiler.

Version 1 for IBM MVS mainframes is currently available for $25,000. Prices of Q/Auditor vary for other systems.

INSIDE

Gold Hill Computers and Intel are developing a LISP version for the Personal Super Computer technology/**26**

Computer Concepts upgrades its Dossier line of data center management tools/**26**

NEW THIS WEEK

- Triangle Software introduces three Cobol maintenance utilities

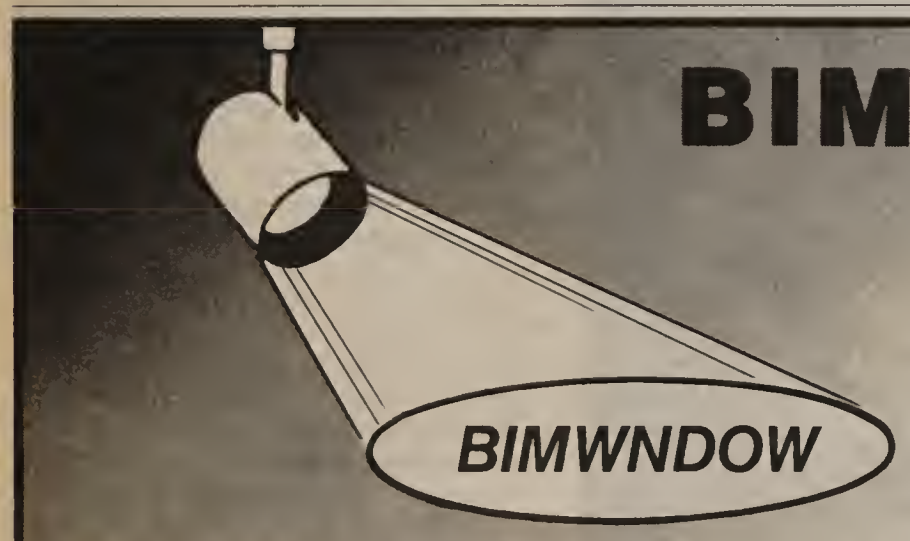
■ For more on these and other new products, see pp. 77-94.

INSTANT ANALYSIS

"You have to keep up with the field of information technology because it is constantly advancing. Software vendors tend to have nice ideas to begin with, but they don't spend the money needed to keep up with new ideas from other sources."

— E. F. Codd on the evolution of data base management systems

BIM Spotlight



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Gold Hill, Intel developing LISP for multimicroprocessors

Exec: first AI language on supercomputer

By Edward Warner
Computerworld News Service

CAMBRIDGE, Mass. (CWN) — Hoping to capitalize on what it believes is an approaching era of relatively low-cost multimicroprocessor supercomputers, Gold Hill Computers, Inc. recently announced an agreement with Intel Corp. to develop and market jointly a Common LISP language for Intel's Personal Super Computer (IPSC).

The move marks the first time "any AI language is being put on any supercomputer, period," according to Stan Curtis, vice-president of sales and consulting at Gold Hill.

Curtis noted that high-powered microprocessors have allowed a new type of supercomputer to emerge — a machine that is actually a team of dozens of microprocessors all working at once. This unique variety of supercomputer offers a ratio of potential price/performance far superior to what supercomputers or dedicated LISP machines currently provide, he said.

Today, LISP machines typically offer processing speeds from 1 to 3 million instructions per second (MIPS), have up to 16M bytes of random-access memory (RAM) and cost about $100,000, Curtis said.

By contrast, the IPSC offers 32 microprocessors — each boasting 1-MIPS performance — and 128M bytes of RAM. In such a configuration, the IPSC has a theoretical top speed of 32 MIPS yet costs only $100,000 or so more than a typical LISP machine, according to Curtis.

From a user's standpoint, he said, the announcement points the way to a time when a business or laboratory can buy an artificial intelligence machine, running at supercomputer speeds, for what a minicomputer now costs.

That, Curtis predicted, will allow corporations to maintain an AI machine ready for compute-intensive, expert system queries such as, "What will a drop in the prime rate do to investments?" Users will get a response from the expert system application as quickly as they get a number from a mainframe data base today.

The advent of LISP support on supercomputers, Curtis continued, also means that the size and sophistication of AI programs will increase. Since they must access a multitude of rules in microseconds, AI applications are limited by RAM. But while the typical LISP machine has a memory ceiling of 16M bytes, Curtis said, the memory ceiling of a IPSC-type supercomputer could extend well beyond even 512M bytes of RAM.

'Quiet milestones of AI technology'

AI industry analyst Howard Dicken said recently that the Gold Hill-Intel announcement was "one of the quiet milestones of AI technology" but also cautioned that "it will be a long while before this technology travels down to, say, the industrial-user level." For the time being, he said, the ability to run LISP programs on a supercomputer will appeal primarily to researchers in AI and other sciences.

Small supercomputers such as the IPSC operate on the basis of what is known as the hypercube, or message-passing, architecture, which allows microprocessors to operate in parallel, explained John Teeter, Gold Hill's vice-president of engineering.

When Common LISP becomes available for the IPSC in June, Teeter said, the first industries to feel the impact will be research and defense where AI machines are already in great demand.

The rub in all of this, of course, is how efficiently all of those microprocessors will be working together. Although Curtis said that tests using a LISP application in physics research kept "80% of the CPUs in a hypercube busy," the true test of the hypercube concept will come as it runs with a variety of LISP software — which is just what Gold Hill is seeking to provide.

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Dossier tools get extra functions

PORTLAND, Ore. — Computer Concepts, Inc. has enhanced its Dossier line of shop management tools that run under IBM's DOS/VSE operating system.

Dossier Prove, an automated tool that performs documentation, standards and auditing functions, now supports cross-referenced reports for CICS programs. The software detects calls to CICS file controls, program controls and basic mapping functions. Dossier Prove supports command-level and macro-level CICS routines for programs written in Cobol, PL/I and assembler.

A second package, Dossier Browse, has been enhanced to run interactively under IBM's CMS operating environment. A one-year license for either Dossier Prove or Dossier Browse costs $125 per month. A perpetual license sells for $3,750.

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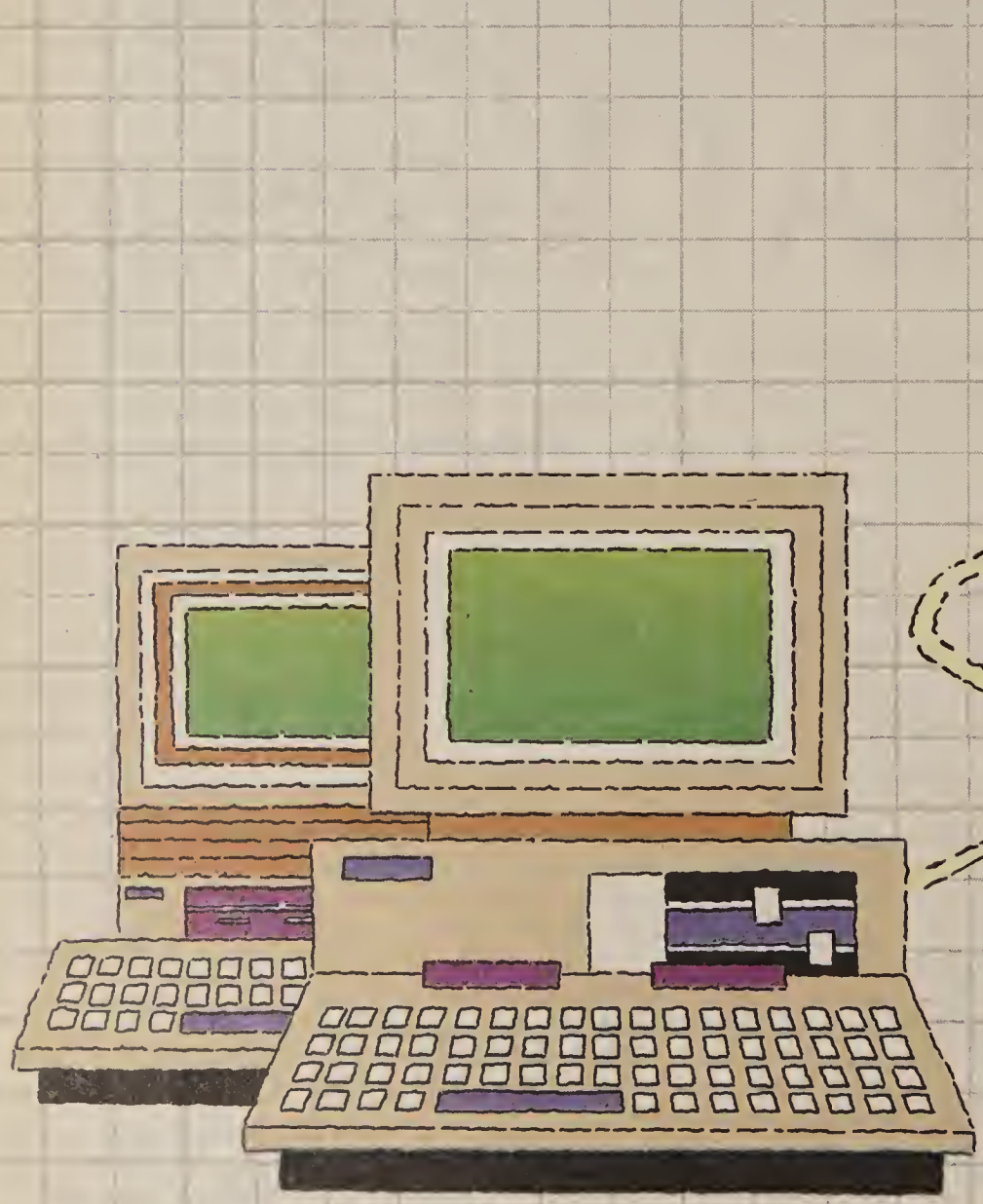

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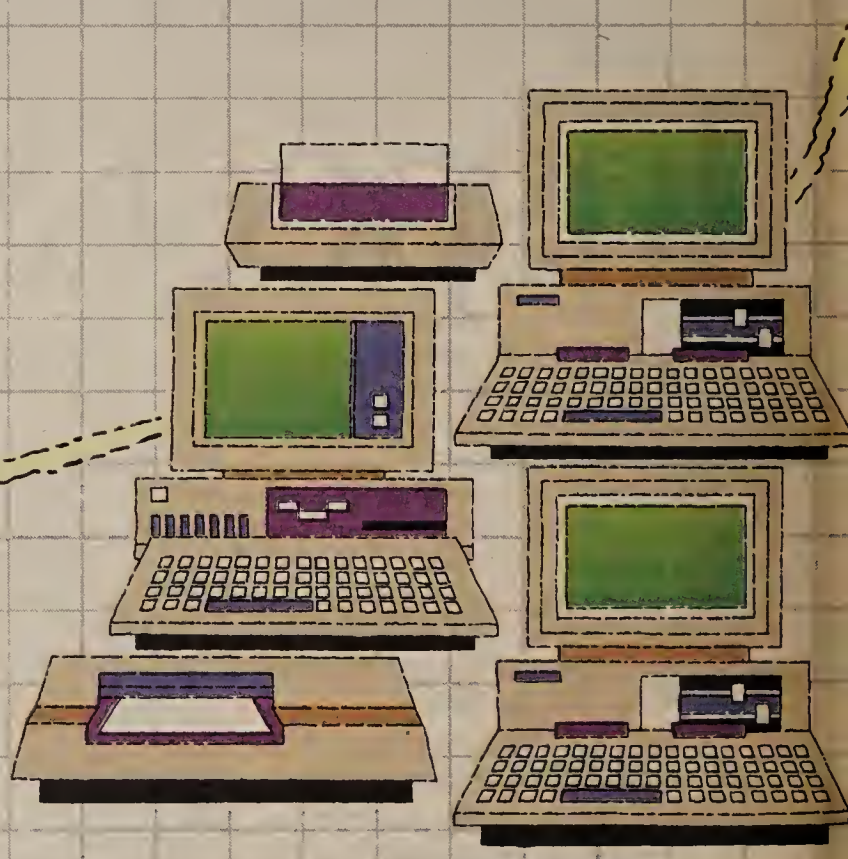

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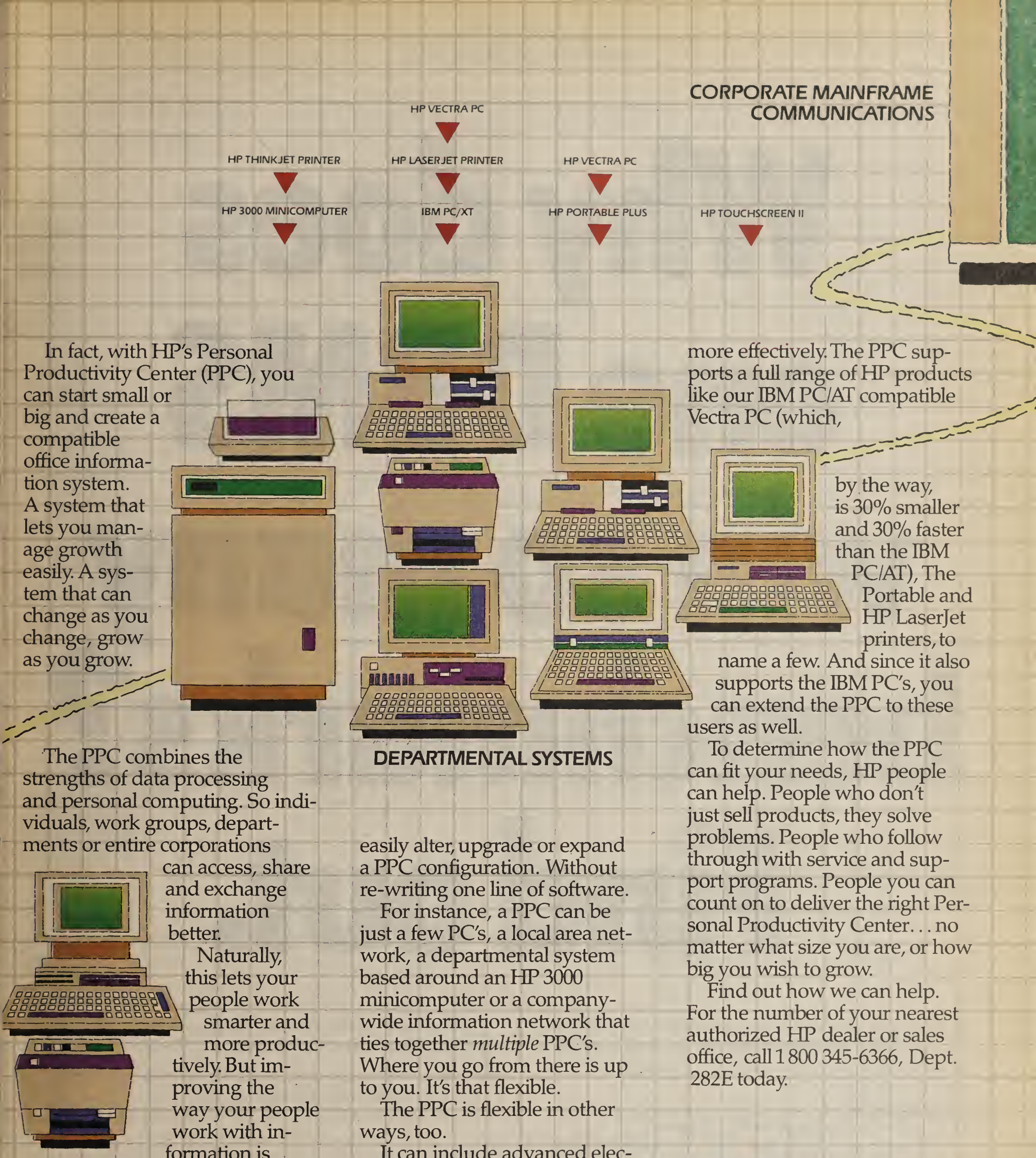

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Notes: Training centers open

From page 25

software development workstation using Inference's **expert system technology**. The workstation reportedly will aid NASA software engineers in the **reuse of existing code** and in the **generation of new code** through symbolic programming techniques. **Symbolics, Inc.'s 3600 series** is expected to be the host machinery for the workstations.

■

Software AG has opened two additional regional **user training facilities.** Developed at a cost of $2 million, the Hasbrouck Heights, N.J., and Lakewood, Colo., centers will provide instruction in the use of Software AG products such as **Natural** and **Adabas**. The company also unveiled three new **training courses.**

■

Prime Computer, Inc. has acquired marketing rights for **Execucom Systems Corp.'s IFPS/Plus** modeling and analysis package. Prime will market the product, which combines the **Interactive Financial Planning System** and a relational data base management system, for its **50 series** computers.

NCR Corp. will be marketing a version of **Digital Communications Associates, Inc.'s Irma** microcomputer-mainframe communications board thanks to an **OEM agreement** penned by the vendors. NCR's Irma offering will support all current features, including transfer of text and binary files.

■

Data General Corp.'s Field Engineering unwrapped a new **service plan** that allows users to extend software support for one DG system to an unlimited number of systems for a **flat monthly fee** per system. The multisystem **Software Product Service Agreement** will provide field and telephone support for multiple systems that run the same software packages on centralized or dispersed locations.

See **NOTES** page 32

Software AG enhances link

RESTON, Va. — Software AG has released a new version of its micro-mainframe link, Natural/Connection. Version 2 is designed to operate with the IBM Personal Computer family and in conjunction with Natural, Software AG's mainframe fourth-generation language.

Improvements in Version 2 include increased functionality, speed and ease of use. Whereas Version 1 menus were fixed, Version 2 menus can be tailored for, or by, specific users. It allows users to access transparently mainframe applications through stored commands. Mainframe data is transparently converted into a user-selected personal computer format.

Other features of Version 2 include task switching capabilities that let users suspend one application and work on another. The original task is later retrieved by hitting the function key again. Another feature is unattended workstation support, allowing tasks to be scheduled and performed whenever a user chooses.

The upgrade will be provided to existing Version 1 customers at no charge. For new users, the mainframe cost varies with the operating system as follows: $15,000 for DOS/VSE, $20,000 for VM/CMS and OS/VS1 and $25,000 for MVS. Personal computer kit prices vary with quantity, from $1,000 apiece for 10 or fewer to $250 each for more than 1,000 kits.

On-line system tracks litigation

From page 25

IBM 3270 emulation capabilities) connected by dedicated lines to the mainframe, or through a cluster dial-up system using an IBM 3274-like controller made by Telex Computer Products, Inc. and a General Electric Co. 4.8K bit/sec. modem.

Schwartz and Newman designed the information system with an emphasis on easy-to-use data screens driven by function keys and menus. "It should make everything look simple," Newman said. "That's why you have programmers."

After studying user needs and data flows, the system staff developed the on-line screens quickly for a prototype version and had users test them before starting the full-scale programming effort, Schwartz said.

The MIS department selected the Cullinet package for a variety of price and performance reasons. For example, Schwartz and Newman pointed out that the network architecture of IDMS/R is important for handling the complex data relationships inherent in the case tracking system, and migration to Release 10 of the package brought enhanced security, data dictionary and on-line query features.

Gradually, users are accepting the new system as they find they can generate ad hoc reports quickly with reliable data, Schwartz said. For example, lawyers can select data screens that show prior or active investigations that are similar to their assignments and discover which government lawyers have applicable expertise. Direct user access to the data base — without intervention by the MIS department — is crucial at a time when the MIS staff is shrinking due to federal budget cuts, he said.

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Changes favor end-user access

From page 25

ments in personal computer technology as well as in end-user support facilities such as executive information systems, decision support systems and high-productivity application development systems. This new technology can be used to build a computerized corporation.

The first step in making use of the revolution in information technology is to define an effective end-user computing strategy. The objective of the strategy is to target specific end users who are making high-dollar-value decisions and to provide these targeted users with much better access to information. The approach is to get the right information to the right decision makers so they can make better decisions.

The next step is the definition of an appropriate hardware/software architecture. Modern computer architectures for end-user computing maintain networks of personal computers tightly integrated with departmental processors and/or mainframes. An important component of the overall design is a clear definition of both the data and the communications architecture.

The implementation of an effective end-user computing strategy frequently requires a major reorganization of the existing information services organization. This reorganization often involves splitting information services into an end-user support group and a traditional systems development group, both reporting to a business-oriented chief information officer. Most information services managers recognize the need to provide much more proactive support for end users. They should promote, not impede, the movement toward end-user computing and the development of a proactive support organization.

Software tools should not be selected until after the end-user computing strategy and hardware/software architecture have been defined. High-productivity, fourth-generation language tools should be selected according to their ability to support end users and DP professionals within an integrated network of personal computers, departmental computers, mainframes and distributed data bases. Desirable characteristics of such tools include at least a 10:1 improvement in productivity over Cobol and excellent human factoring.

One of the most important criteria in the selection of tools for end-user computing is the availability of support for personal computers. The personal computer is rapidly gaining acceptance as the key component of an end-user computing strategy.

Close integration of micro and mainframe facilities is an important component of end-user computing. At a minimum, support for the personal computer should include the ability to extract mainframe data and download the data transparently to the personal computer in a variety of standard personal computer data formats. In addition, the micro user should be able to process the downloaded data using either standard personal computer tools or a personal computer version of a mainframe, fourth-generation language tool. Prototype applications developed on the personal computer should be transportable without change for operation on the mainframe.

Exceptionally good human factoring is a growing requirement for end-user tools. There is no longer an excuse for tools that use alien syntax, specialized command languages or hard-to-remember codes. Users should look for tools that are graphics oriented and support rapid selection of menu items or icons using pointing devices such as a mouse or a touch-sensitive pad. Tools should be user seductive — in other words, they should be able to engage the user fully in a rapid sequence of interactions focused on the solution of a business problem.

Additional improvements in information technology directed primarily toward DP professionals include the availability of greatly improved design processes and the growing integration of expert systems technology with high-productivity languages. Sophisticated design automation tools that provide a detailed, on-line analysis of a specification as it is entered are now available. Some of these tools are beginning to use artificial intelligence techniques to aid in the detection of design errors.

Notes: Firm inks financing deal

From page 31

Master Software, Inc. and **Vendor Funding Co.** have inked an agreement through which Vendor Funding will finance **user purchases** of Master Software's **Programaster Cobol** applications development system. Master Software claims the deal is the first such third-party software financing arrangement. Under the deal, the financial firm will provide **36-month terms** for users.

■

Control Data Corp. unwrapped a site licensing program for **nonprofit higher education institutions**. A CDC spokesman said that for an annual fee of $1,950 per course, an institution can reproduce in any quantity **Plato college-level educational software.** The Plato series software covered by the site licensing program are the **IBM Personal Computer versions** of CDC's **Lower Division Education Curriculum**.

MICROCOMPUTERS

SMALL TALK
Eric Bender
CW Senior Editor

Trudging out of a Stone Age

If technology is an army on the mareh, then at any given time the army's scouts are enjoying the view from the mountaintop, but the rest of the troops are miles back, slogging painfully through swamps that seem to extend to the horizon.

Our readers are never shy about pointing this out to us. Idly looking at some "artificial intelligence-based" software earlier this month, I answered the phone and found myself chatting with the chief information officer at a very large Midwestern organization. He summed up his struggle neatly: "We're still in the Stone Age here."

Grappling with limited budgets and unglamorous tasks like explaining the "A>" prompt and troubleshooting aging disk drives, micro managers also must deal continually with technological fixes that don't quite work.

That thought comes up again and again, most recently when wading through a pile of new software offerings that claim AI techniques and wondering when those techniques will make much difference in the real world.

Of course, "AI-based" doesn't necessarily mean much. As computer pioneer Alan Kay points out, spelling checkers were AI 20 years ago. From a researcher's point of view, AI is any hot software that's not about to leave the lab.

On micros, most of what is promoted as AI might be better described simply as clever programming.

But some programs clearly do represent something different. Even here, though, the technology does not necessarily provide much help. Symantec Corp., which offers a natural language interface for its Q&A integrated data

See **TRUDGE** page 36

Microsoft revamps Project

Software tackles bigger jobs in more formats

By Peggy Watt

BELLEVUE, Wash. — Microsoft Corp. has shipped a new version of its project management software, Microsoft Project, that can handle larger projects and chart tasks in new formats and includes a new on-line tutorial.

Version 2 of Project, which runs on IBM Personal Computers and was originally introduced in July 1984, can handle as many as 255 resources and 999 activities, said Phil Welt, product marketing manager.

The new version also includes Pert as well as Gantt charts, allows schedules to be broken into increments ranging from minutes to months and can chart comparisons of planned and actual schedules, Welt said. On-line Help files also were revamped.

Project enables users to enter information in a spreadsheet-like design and to build charts to schedule and track tasks, costs and resources using the critical path method. Ten new report formats, including network (Pert) charts, are available in the new version, for a total of 14 formats.

Version 2 is priced at $395, up from the $250 price tag for Project 1. The higher price will "send a signal to the market that this is a full-featured, business-oriented product," Welt said. Current users may upgrade for $125. Demonstration disks are available for $10.

A typical Project user is juggling a task that has 50 to 60 activities, that will take more than six months to complete and that involves a $150,000-plus budget, Welt said. The user is "pretty technically oriented," he added. "We thought that general managers would use it. But we've found that the people who use them were engineers and DP/MIS manager types."

See **REVAMPED** page 36

Tool saves data for easy transfer

By Eric Bender

BRYN MAWR, Pa. — Goldata Computer Services, Inc. has introduced Your Move, a memory-resident utility that captures onscreen data for use as keyboard input, thus providing a straightforward method of transferring data between various programs.

"People on PCs always want to share data between applications without rekeying," but programs often lack suitable import and export facilities, noted Goldata President Elliot Goldberg. Even when those facilities are present, Goldberg said, they may operate in a clumsy fashion — for example, users cannot select the fields of data they want to transfer.

Priced at $29.95 until Jan. 31 and $59.95 thereafter, Your Move permits users to mark areas on the screen in which data is to be captured, with the data then stored in a random-access memory buffer or on disk.

Users then can run their application software and input the captured data by hitting one function key.

The utility also features a macro facility that enables users to store a sequence of Your Move commands and execute them with one keystroke, Goldberg said.

Shipping last month with a 60-day, full-refund guarantee, Your Move runs on IBM Personal Computers and compatible systems and takes less than 32K bytes of internal memory.

The software runs with other memory-resident programs such as Borland International's Sidekick but conflicts with a few packages that grab control of the keyboard, such as Samna Corp. word processing programs, according to Goldberg.

Goldata is a 10-year-old firm that started out in time-sharing and consulting and subsequently moved into microcomputer data base management software. The supplier hopes to sell 12,000 copies of Your Move in the product's first year, Goldberg said. "If it saves two hours of clerical work, Your Move pays for itself," he claimed.

NEW THIS WEEK

- ARC Systems announces a PC.25 communications package
- Lattice offers the Lattice Screen Editor
- For more on these and other new products, see pp. 77-94.

INSTANT ANALYSIS

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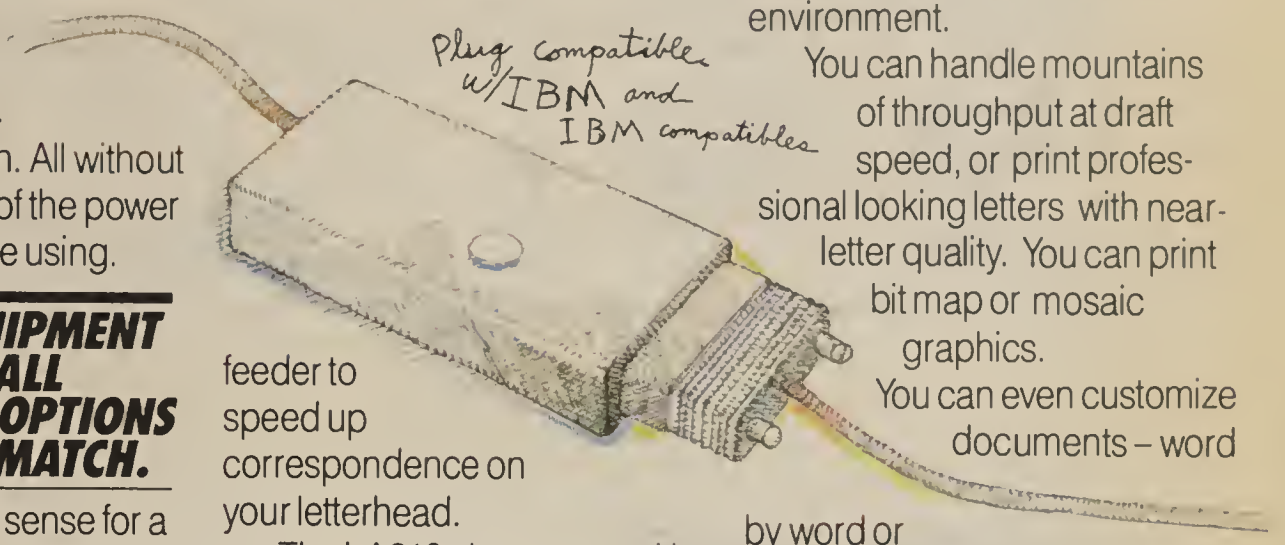

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MICROCOMPUTERS

Revamped Project out

From page 33

Beta users, who have been using the new version since September, said the new scheduling features are among their favorite enhancements.

"I'm really fond of its ability to shrink or expand the time frame on the screen in a Gantt chart" as well as schedule by the hour, said Dick Neuman, Westin Hotel Co.'s systems and programming manager for corporate data processing in Seattle.

He said he likes the new version's ability to compare forecasts and actual results, something he could do before only through an interface he wrote between Project 1 and Microrim, Inc.'s Rbase 5000 data base manager.

Neuman helped beta test the update after using Project 1 for about a year to manage data processing development projects. The new network charts proved helpful in a major project, planning and scheduling equipment purchase and installation.

Anchorage Telephone Utility management assistant Marvin Barnes turned to Project to plan and implement a new customer records system.

"Microsoft Project gives us the structure to put tasks in a logical sequence, track all our resources and do an estimated budget," he said.

Because the program uses standard text characters, it can run on some Microsoft MS-DOS systems that are not IBM Personal Computer compatible, including the Tandy Corp. Model 2000, Texas Instruments, Inc. Professional and Wang Laboratories, Inc. Professional. Project requires MS-DOS 2 or higher and 256K bytes of random-access memory.

Trudge out of a Stone Age

From page 33

management/word processing system, gives one example.

Q&A is "the only microcomputer software with built-in intelligence," the company suggests. The natural language approach was designed to simplify life for users, bypassing the biggest problem with traditional data base managers, who "were great after some guy with a degree in computational linguistics set them up for you," key developer Gary Hendrix commented.

But while the package is well designed and executed, it's not clear that the natural language portion achieves much more than gimmick status. A solid technical structure underlies Q&A's natural language facilities, but many users will tire of answering on-screen questions such as, "Shall I do the following?" or "I don't know the word highlighted above. What would you like to do?"

If a boom in local-area nets finally arrives this year, we'll learn a lot about multiuser micro software in a hurry. The air will fill with thousands of complaints about mysterious bugs, complicated access schemes and uncooperative printers.

But all the time progress is being made — think how magical Q&A would have appeared three years ago when the standard data base manager was Ashton-Tate's Dbase II or how handy those networks will be when they finally get up and stay up. We're moving ahead, one swamp at a time.

SCIENCE/SCOPE®

A cryogenic refrigerator designed to cool infrared sensors has passed a test equivalent to operating three years in space. The Vuilleumier cycle cooler, set in operation at twice its normal speed in order to simulate a design life of five years, has passed the year-and-a-half point of flawless operation. The device will be used with infrared sensors in space for applications such as defense and geological surveys. The sensors must be chilled to near absolute zero to maintain adequate sensitivity to low-temperature thermal radiation. The VM cooler, developed by Hughes Aircraft Company, is believed to be the only one of its type to have performed this long at such low temperatures.

Demonstrating a key feature of its advanced capabilities, an Amraam missile scored a direct hit on a target aircraft while receiving new target data en route. The test was the fourth consecutive success in the full-scale development program. The unarmed missile was launched from an F-16 flying at supersonic speed at 25,000 feet. The target flew in a head-on approach just below supersonic speed at 20,000 feet. The missile initially flew under control of its on-board inertial reference unit, using target coordinates provided by the F-16's radar before launch. The missile then received post-launch target updates from the F-16 through the radar data link communications system. It used this information to confirm it was on course, or to modify its heading if necessary. In the latter stages of flight, the Amraam switched to its terminal mode using its own active radar. Hughes is developing the AIM-120A advanced medium-range air-to-air missile for the U.S. Air Force and Navy.

An experimental digital-to-analog converter chip is 10 times faster than the fastest conventional device. The chip, being developed at Hughes for advanced airborne radars, uses gallium arsenide as the substrate material. It has a settling time of 200 picoseconds, about an order of magnitude faster than a record-holding 6-bit Hughes silicon device. The new converter so far outdistances commercial devices that design engineers are developing special interfaces so that the device can be hooked up in data conversion systems for further testing and analysis.

Battle management will get sophisticated new automated support when NATO's northern region installs a new system containing what may be the most complex large data base ever built. The system, known as NEC CCIS (Northern European Command, Command and Control Information System), will provide a secure network of computers and displays to support the commanders and staffs at 18 operations centers throughout Norway and Denmark. It will span echelons of command from squadron operations rooms and NATO air defense control centers to regional command headquarters. The system will gather, store, process, and display data to support the range of operational disciplines involved in multiservice battle management. Included are detailed status data on friendly units and intelligence on enemy forces. The system will help commanders use resources effectively and issue orders to tactical units. Hughes heads a team of Norwegian and Danish companies developing NEC CCIS, which is scheduled to go into operation by the end of the decade.

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SYSTEMS & PERIPHERALS

HARD TALK
James Connolly
CW Senior Editor

Industry preps for new season

The holiday season is over. The football season is almost over. The baseball season is a warm promise for the months to come. What opens now is the announcement season.

DP managers who have waded through the mail and messages that built up over the holidays can expect a flood of product announcements and an accompanying sales push from vendors.

None of the products should impact the computer industry as solidly as did IBM's early 1985 announcement of the 3090, whose sales reportedly accounted for 1% of the U.S. gross national product for the fourth quarter of 1985. But the products could reposition companies in several markets.

A uniprocessor version of the 3090 — the Model 100 — seems a sure thing as an announcement, with the only question being when the news will arrive. Analyst Mike Chuba of the Gartner Group, Inc. predicted it will come in February, while analyst Frank Gens of International Data Corp. said it will be announced in January.

In superminicomputers, Gould, Inc. will have a processor and several AT&T Unix-related software introductions this week. Rumors are that Digital Equipment Corp. announcements will include a new Microvax system or a Microvax cluster within two weeks.

Two products expected to break technological ground are IBM's engineering workstation and Hewlett-Packard Co.'s Spectrum superminicomputer, both based on reduced instruction set computer (RISC) architectures. The RISC machines were due in late 1985 but were delayed by software glitches.

The HP machine will be offered initially as a high-end replacement for the HP 3000 and probably will be introduced in February. However, the IBM workstation may be out as early as next Tuesday, Gens and Chuba noted. Chuba added that the IBM workstation and the Model 100 are ready and await only

See **SEASON** page 40

Eternity now fault tolerant

System availability guaranteed in single-point failures

By Jeffry Beeler

SAN JOSE, Calif. — Tolerant Systems, Inc. has enhanced its family of on-line transaction processing hardware to support fault tolerance — a capability the products previously lacked.

Since its introduction in December 1984, Tolerant's Eternity processor has supported the data integrity features that all on-line transaction processing applications and systems demand, but it now guarantees continuous system availability in the event of any single-point failure, according to Tolerant's Marketing Director Shirley Henry.

The Eternity series' fault tolerance has been made possible by the addition of a system interconnect bus, which consists basically of dual Ethernet controllers. The interconnect bus permits up to 15 of Tolerant's System Building Blocks to be tied together in a single-system image.

As is reportedly the case with other on-line transaction processing systems like those of Tandem Computers, Inc., the Eternity series provides for linear expansion of processing power, Henry said. The firm claims that two tightly coupled System Building Blocks furnish twice as much performance as one machine, while adding a third unit boosts throughput threefold.

Each System Building Block consists of three main components: a user processing unit, a real-time processing unit and an I/O processor. All three components are built around 10-MHz National Semiconductor Corp. 32016 microprocessors and reside in a single cabinet.

In addition to the integrated CPUs, the System Building Blocks are configured with 32016-based communications interface processors. The system interconnect bus operates under control of the real-time processing unit. Except for the acquisition of the dual-channel controller, the Eternity line remains essentially unchanged.

The product line distributes Tolerant's Transaction Executive operating system, which is based on University of California at Berkeley's Unix 4.2, across its three integrated processors.

Tolerant will continue to sell its products through systems integrators and OEMs. In general, the Eternity product line is geared for the same applications as its Tandem counterpart, with the financial services industry and computer-integrated manufacturing accounting for the largest share of sales.

A minimum-configuration Eternity system consisting of two System Building Blocks, 8M bytes of main memory, two 128M-byte disk modules and two copies of Transaction Executive costs $190,000.

Plexus Unix-based P/75 system targets multivendor environments

By Rosemary Hamilton

SAN JOSE, Calif. — Plexus Computer, Inc. rolled out its top-of-the-line AT&T Unix-based computer last week that it said supports up to 80 users.

The P/75, dubbed a departmental computer, is targeted at multivendor environments. "Typically, what we get from customers is a whole long list of things that we have to connect to," said Kip Myers, a cofounder and vice-president of corporate development. "It would have been dumb of us to have a strategy that directly went against IBM."

The P/75, which has an entry-level price of $36,000, uses a Motorola, Inc. 68020 job processor and can be configured to include up to 16M bytes of main memory and 6.5G bytes of disk storage. It operates under Unix Version Sys5.2, a Plexus adaptation of Unix System 5.

The system uses the company's new front-end processor, called the Advanced Communication Processor (ACP), a single-board attachment that performs the I/O and communications functions. ACP supports IBM Systems Network Architecture, IBM Binary Synchronous Communications, commercial X.25 and Defense Data Network protocols, the company said. When communications functions are downloaded to the ACP, the job processor is freed for other tasks.

Because of the ACP, Plexus said the P/75 can perform up to twice as fast as the P/60, which had been the company's high-end offering. Myers said the company does

See **PLEXUS** page 40

INSIDE

Texas Instruments enhances its Business System series minicomputers/**40**

NEW THIS WEEK

- Scientific Micro Systems offers a DEC-compatible storage subsystem
- Forward Technology introduces the Graphtext I workstation

■ For more on these and other new products, see pp. 77-94.

INSTANT ANALYSIS

"We in the industry keep predicting the demise of the mainframes quite prematurely. They are still around. They still account for the major portion of information processing and will for [longer] than the foreseeable future, regardless of how many personal computers we put on people's desks."

— Roy Beers, vice-president, Burroughs Corp.

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TI adds memory to mini lines

AUSTIN, Texas — Texas Instruments, Inc.'s Data Systems Group has announced enhancements, including additional memory and a Cobol accelerator, for its Business System Series 600A and 800A/B minicomputers.

The 600A series is now available with up to 1.5M bytes of on-board memory, in addition to the previous 512K-byte and 1M-byte configurations. The 800A/B series, with a previous maximum random-access memory of 512K bytes, is now available with 1M byte of memory.

Prices for 600A configurations begin at $28,995. Prices for the 800A/B begin at $41,995.

The Cobol accelerator is manufactured by Ten X Technology, Inc. and is available as an option for the 600A and 800A/B. It was designed to relieve bottlenecks caused by overloads of Cobol programs by off-loading non-I/O Cobol. It costs $5,795.

Plexus P/75 system bows

From page 37

not measure performance in millions of instructions per second directly but in a series of benchmark tests in which the P/75 performed from 1½ to three times faster than the P/60.

While the computer can accommodate up to 80 users, Myers said a typical configuration would be between 30 and 50 users, which would sell for between $50,000 and $60,000.

The minimally configured standard, supporting up to 16 users, comes with a 15-slot card cage, 1M byte of error-correcting main memory, a 60M-byte cartridge tape, a mass-storage processor and a 145M-byte, 8-in. Winchester disk drive.

Myers said the P/75 is compatible with the Plexus line. An upgrade kit for the P/60, which is a trade-in of the Motorola 68000 CPU for the 68020, costs about $4,000.

Season opens for industry

From page 37

briefings of the sales force.

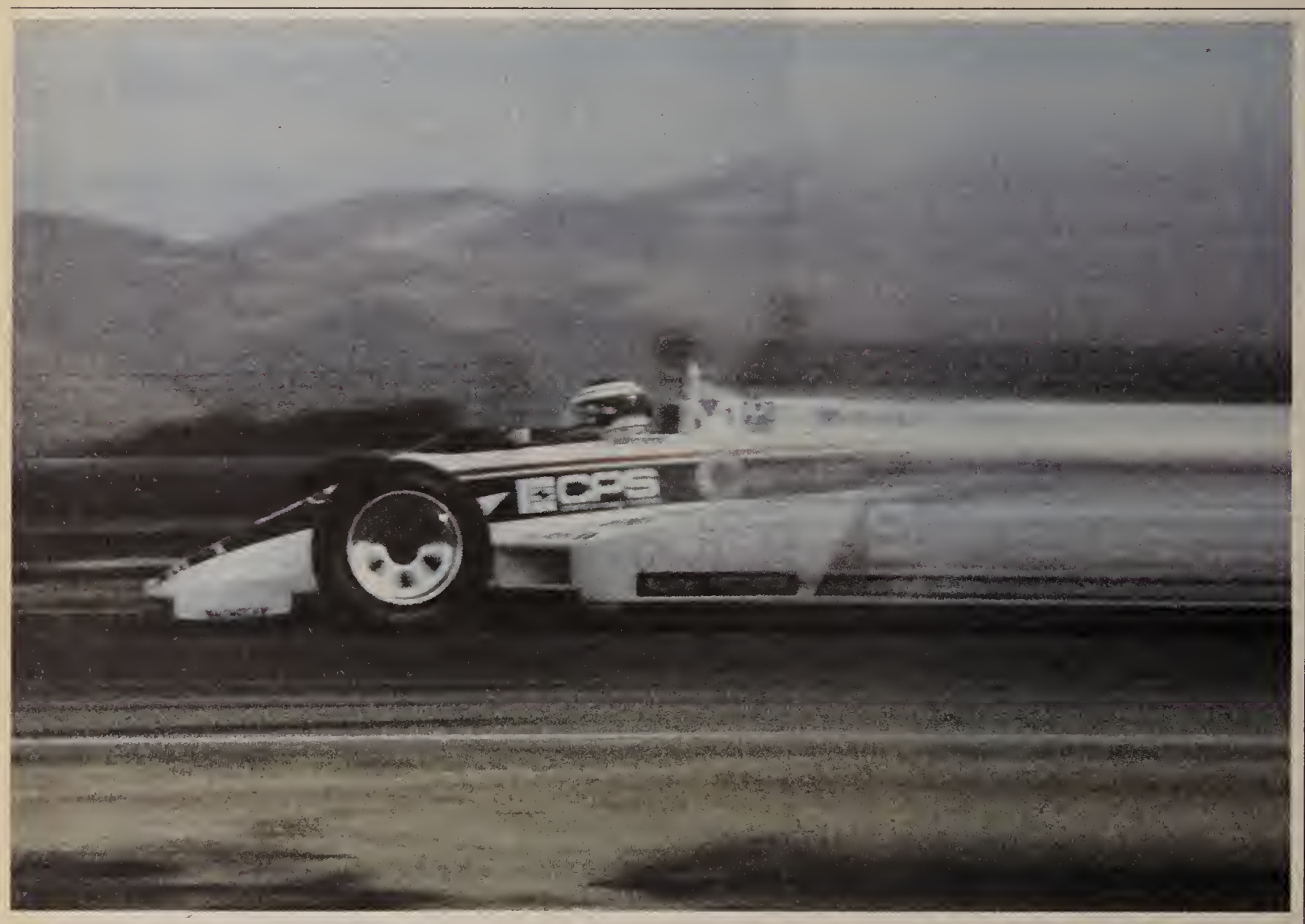
"IBM will have announcements every other week or so from now right through the end of the first quarter," Chuba said. He said other IBM products expected in the coming months include a replacement for the 3274 controller, a 3800-class printer, a low-end version of the 3480 cartridge tape drive and an autoload feature for the 3480.

Gens noted that IBM will concentrate on reducing the price/performance ratio for its 4300 series to guard against DEC and Data General Corp. attacks in that low-end mainframe and supermini field. IBM is "caught in transition" with its 4300 family of low-end mainframes and superminis, according to Gens, who noted that DEC and DG claim price/performance ratios that are half those of the 4361 and 4381, with a replacement for the 4300s not expected until 1987.

To answer DEC and DG, IBM probably will introduce a 7 million instructions per second version of the 4381, a uniprocessor 4381 and a low-end 4361, Gens said. He said he also expects price cuts of 30% to 40% for existing 4300s and cuts for the remaining 3080 mainframes that were supplanted by the 3090.

According to Gens, IBM will focus on delivering products as soon as possible after they are announced. For example, he said he expects the Model 100 to be announced in January and delivered as soon as the second quarter of 1986.

If the rumor mills are right, most of these announcements, in addition to the usual surprises, should come in the next six weeks. It's clear that the computer industry, which offered little for a month, is snapping out of its annual holiday daze.



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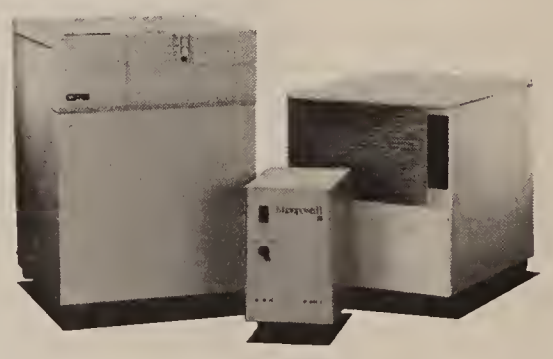

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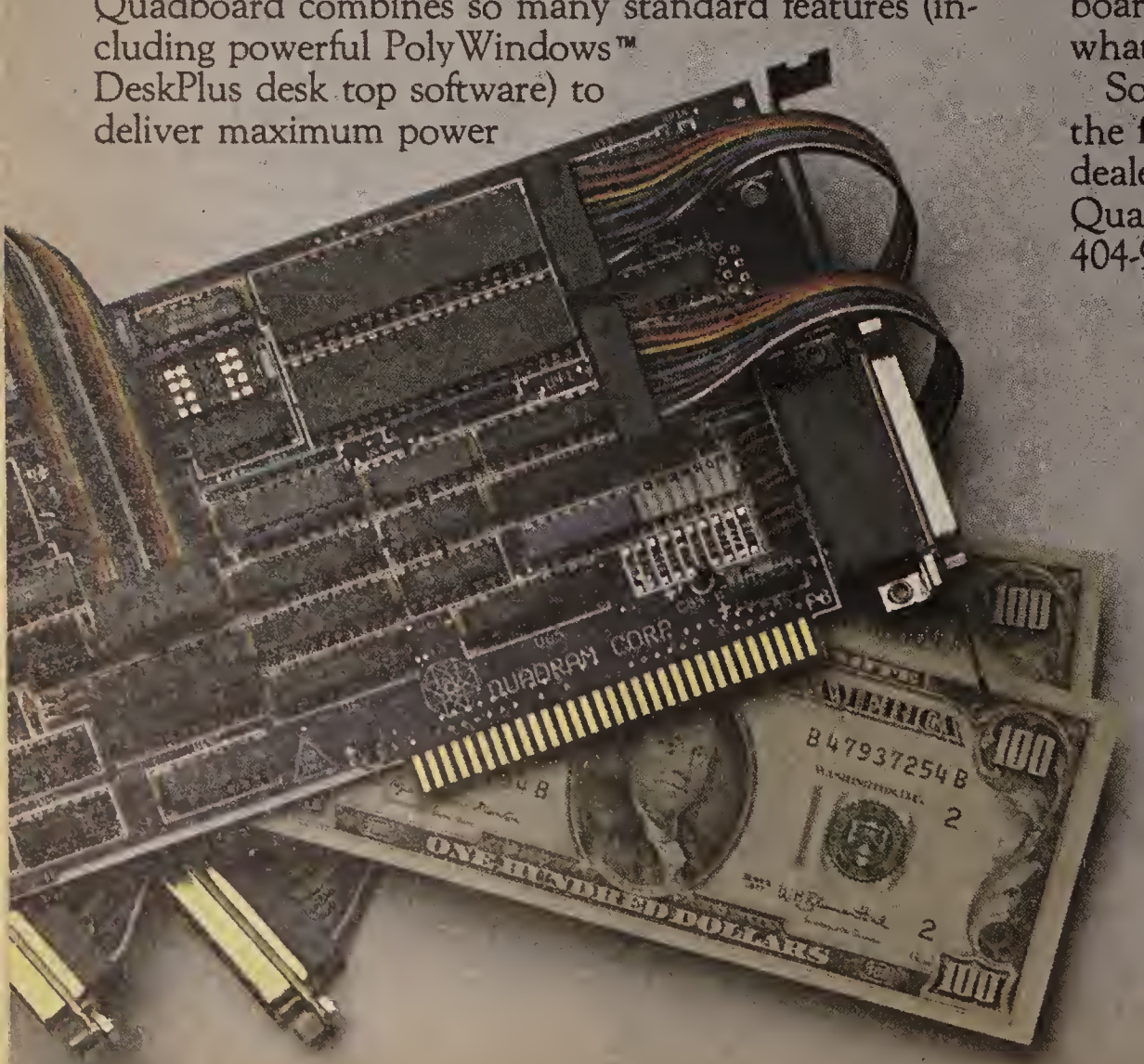

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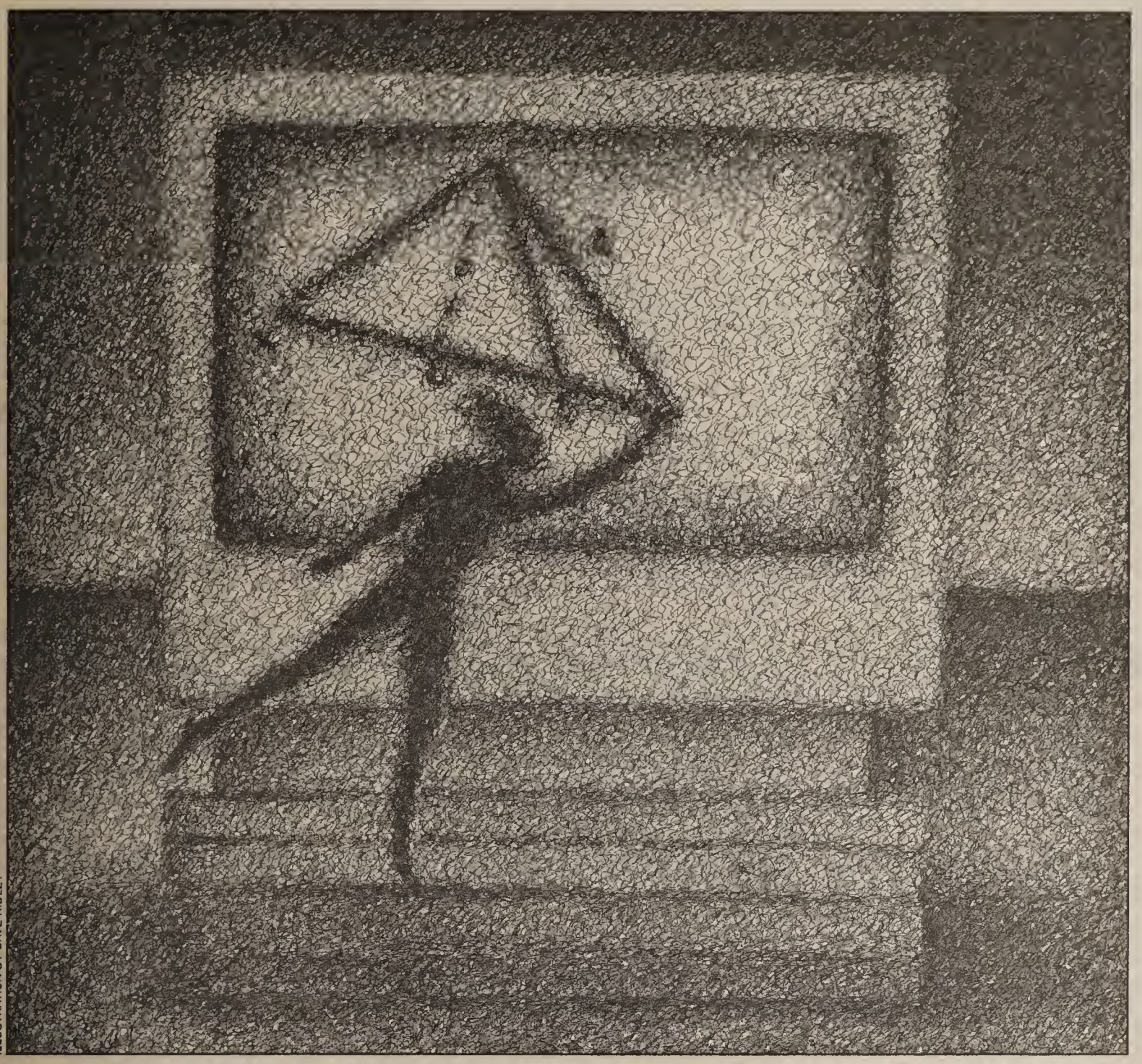

ILLUSTRATION BY DAVE RIDLEY

Expert Systems

The promise of a smart machine

By HARVEY P. NEWQUIST III

Expert systems — computer programs that use human traits like logic to solve problems — will serve as the vanguard for the advance of artificial intelligence into the office. They are the first of AI's new-wave technologies that MIS managers must meet head on.

These systems, which sort and crunch knowledge much as traditional computers sort and crunch numbers, are better suited to office use and are further along in development than any other artificial intelligence technique.

Whether or not they are far enough along to bring most organizations strategic benefits remains open to question.

One one hand, about half of the companies in the Fortune 500 actively pursue expert system development, many with the hope of gaining an edge against competitors. Their interest gives the technology quite a bit of credence. Lockheed Corp., Digital Equipment Corp., General Electric Co., General Motors Corp. and Boeing Computer Services Co., for example, all have either begun in-house development or invested in expert system companies. Very few firms in this league ignore the technology altogether.

On the other hand, few expert system success stories have come to the business community's attention. And, frankly, there aren't too many success stories out there.

Most large-scale expert system development remains just that — development. For the most part, innovators in the field are currently finishing up on prototype systems; they still face great obstacles on the road to full implementation. Whether or not expert systems will work their way into corporations on a narrower scale is not open to doubt. They will, and MIS managers must prepare themselves.

Expert systems will infiltrate organizations department by department, much as personal computers did before them.

Generally, MIS departments are not taking the lead in expert system development. Most shops are holding out until vendors can offer a link between the symbolic environment preferred for expert system development and the standard DP environments preferred for day-to-day business processing.

But while MIS waits for this missing link, users and top management will forge ahead with their own experiments in expert system use. DP professionals must keep abreast both of developments in technology and of action within their own

Continued on page 44

Newquist is editor of "AI Trends," an artificial intelligence newsletter published by DM Data, Inc. of Scottsdale, Ariz.

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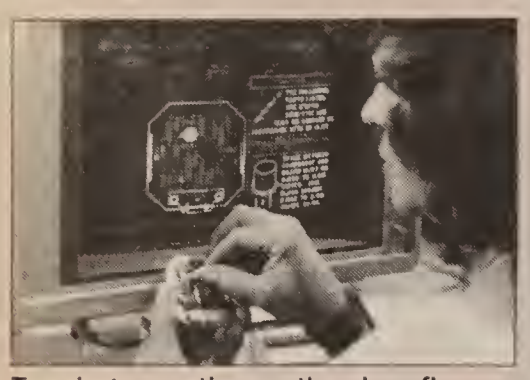

Tapping expertise on the shop floor

User's system a great success

EL SEGUNDO, Calif. — LISP may be the language of choice for artificial intelligence programmers, but the developers of one highly successful expert system chose to get by without it.

Developers in Hughes Aircraft Co.'s Electro-Optical Product Operations Division started their Hi Class expert system in Fortran, revised and enhanced it in Pascal and ported it to C, under which it is currently running. Hi Class solves circuit board assembly problems and provides on-line instructions to workers on the firm's factory floor.

According to Joel Schnur, the division's manager of computer-aided manufacturing, Hughes shunned LISP for two reasons: First, the firm wanted to use languages that its existing staff understood because LISP programmers were extremely hard to come by. Second, it wanted to keep its hardware options wide open. "We knew that the desirable hardware configuration would change every 90 days," Schnur explained, and LISP ran only on a limited set of machines.

Initially, Fortran put the firm at a distinct disadvantage because the language was not designed for expert system development. After the problem-definition stage, however, the project advanced at a healthy clip.

Hi Class development began in 1981 on a Hewlett-Packard Co. HP 3000 and switched over in 1983 to an Apollo Computer, Inc. 32-bit processor. The system went into production in November 1984 and has been running full-time since then on a network of Apollo processors and Tektronix, Inc. display terminals.

Because Hi Class now runs in C, Hughes expects little trouble changing configurations as corporate needs evolve and manufacturing technology moves forward. The system has won favor with managers and shop floor workers alike. It cuts by three-fourths the time that manufacturing planners need to translate engineering drawings into practical assembly instructions, and it saves workers the trouble of routing through manuals when they need help performing an unusual assembly process. Most important, Schnur said, it helps Hughes turn out circuit boards of consistently high quality.

Hi Class supports assembly lines for only two of Hughes' circuit board products right now, but the system will expand considerably early this year. And General Motors Corp., which recently acquired Hughes, has shown some interest in taking Hi Class even further.

— Becky Batcha

The promise of smart machines

From page 43

organizations, so they can integrate expert systems into mainstream computing environments when the tools that allow this merger come to market.

Users will clamor for expert systems soon — and with good reason. Because expert systems accumulate, assimilate and analyze information with incredible speed, these tools can help managers make better decisions.

Given their attractiveness to users, expert systems will infiltrate most organizations department by department, much as personal computers did before them. The onslaught will begin early this year as packaged expert system applications come to market.

These applications are to expert systems what Lotus Development Corp.'s Visicalc and Micropro International Corp.'s Wordstar were to business micros: They are task-specific tools that let end users exploit a technology on their own, without much help from programmers.

Another aspect of expert systems — their proficiency at solving narrow rather than broad problems — indicates that these tools will enter organizations haphazardly rather than following a centralized, controlled plan.

Initially, most organizations will develop expert systems as individual fringe projects, usually within a single department or division. These systems, built to perform well-focused tasks like oil exploration or aircraft engine analysis, will have little relation to the data base management systems and financial reports generated within the MIS department.

Therefore, they will stay, for the time being, outside the umbrella of corporate DP.

Yet MIS managers must prepare to take part in the utilization of expert systems. As these systems become more prolific and take on tasks such as asset management and intelligent text retrieval that do affect the corporate host, MIS departments will need to assume control.

Right now, MIS managers would be well advised to learn all they can about expert systems. A keen understanding of what an expert system can and cannot do will help them identify appropriate trial applications; knowledge of expert system development methods and tools will help them carry out initial projects with success.

MIS managers must also keep watch for key technical advances in hardware, software and communications. These developments will signal that the time to act with greater urgency has arrived.

Abilities and limitations

An expert system embodies the traits that most people associate with artificial intelligence. It involves, for example, the use of logic (a decidedly human trait, though not one of which all humans seem capable) instead of relying on pattern matching and recognition (of which even insects are capable).

An expert system can respond to an operator's query about how to solve a problem and can give explanations for its answers. In addition, it can offer suggestions for alternative ways to solve the problem. The expert system operates by interpreting the query and comparing it against facts and rules that reside in a knowledge base — a collection of information gleaned from one or more experts in a given field and from supporting texts. (For more on expert system operations, see story page 50.)

These abilities lend themselves to solving most business problems, but only if the problem's subject is tightly defined. An incident from expert system history illustrates the point. Some of the pioneers of artificial intelligence envisioned an expert system that would rival human chess masters. They succeeded in creating the system, but it could do one thing and one thing only — play chess. Human chess masters, of course, possess a broader range of skills.

Later, expert system developers brought forward more practical applications (see chart page 51). Even the most recent developments, however, share one trait with their early predecessor: Expert systems excel only at solving specific problems within specific areas of knowledge.

They perform with their highest degree of certainty and success in areas like aircraft engine analysis or medical diagnosis, where faults and failures can be traced to a defined origin. For example, an engine fails because of a hairline turbine fracture, and a stomach pain arises from a bleeding ulcer.

An expert system well suited to its task can even outperform people. DEC's Xcon system, which the vendor designed to configure VAX machines for customers, operates with an average degree of success greater than 90%; human operators' success rates for the task average about 70%.

However, in broad, subjective problem solving, expert systems cannot compete. No expert system, for example, could offer suggestions on how to change a business' corporate culture, an endeavor governed by no criteria other than individuals' likes and dislikes. The solution for this kind of problem follows no universal pattern of logic; no expert system can discern it.

Clearly, it is important that companies choose appropriate areas for expert system development. Additionally, they must have the right reasons for going with expert systems in the first place (see Figure 1). Any organization that develops an expert system solely for the sake of bringing artificial intelligence in-house develops the system for the worst of reasons.

WHY DEVELOP AN EXPERT SYSTEM?

CW CHART

- ☑ To preserve knowledge that might be lost through the retirement, resignation or death of a company's acknowledged expert in any field.
- ☑ To "clone" an expert mechanically so his knowledge can be disseminated.
- ☑ To store information in an active form — a knowledge base — rather than a passive one — a textbook or manual.
- ☑ To give novices an aid that will help them think the way more experienced professionals do.
- ☑ To create a mechanism that is not subject to human failings like fatigue and can hold up in positions where information must flow constantly.

Figure 1. No organization should develop an expert system merely to bring artificial intelligence in-house.

Successful systems usually center on an immediate need. The impending retirement of a corporation's sole expert in a given field, for instance, brings on the immediate need to preserve that person's expertise. An expert system can capture the individual's skill for continued and future use by the company or for training less skilled people who aspire to the individual's position.

A corporation may also employ an expert system to fulfill a perceived need to disseminate expertise from its highest echelons down to the level of junior employees. If the firm finds it unfeasible to spare the manpower to educate its junior members, an expert system may come in handy.

In such a case, the expert system will aid and assist experts and novices alike.

Once an organization identifies an application for its initial foray into expert system use, managers must take great pains to plan development efforts. Expert system projects have been known to fail, but proper planning ensures a better outcome.

Managers must take into consideration the huge amounts of time and money that a development project often entails. Before a project gets rolling, managers should make sure it will not run out of steam until it is completed. Technical and psychological factors determine whether an expert system development project will proceed to its envisioned end or whether it will fall apart midway.

On the technical side, managers must make sure that an expert system — a computer program — can solve the problem at hand. Most problems are more complex than they seem on the surface. Overly complex problems lead to overly complicated programs, programs too cumbersome to run day to day.

On the psychological side, managers must see that every potential user feels comfortable with the idea of working with a computerized assistant (or even a mechanized peer). The fear that expert systems arouse

in white-collar workers rivals that which robots stir in blue-collar workers. Generally, the interface between man and machine makes all the difference. A good interface encourages use — not annoyance or disdain.

System shapes and forms

Expert system development efforts follow one of three routes:

- A custom development route, whereby an organization starts from scratch, using AI development languages and highly skilled AI professionals to build a system to its specific needs.
- A semi-custom-development route, in which the organization starts with a commercially available expert system shell and fits that generic program to its specific needs by building a base of knowledge around the shell.
- A packaged route, whereby the organization installs a prewritten application and makes minor adjustments to fit its exact needs.

Resource constraints typically determine what route any one firm can follow. Custom-developed systems require the greatest amount of time, money and professional expertise; systems that rely on packaged applications require the least. Expert systems developed around shells travel a middle ground.

Custom expert systems. To follow this route — the road most traveled by innovators in expert system use — an organization needs access to one of two pools of resources: a talented staff of AI professionals or a consulting firm with experience in knowledge engineering and development.

Once the organization secures the resources it will require and identifies a target application, it must follow a prescribed set of steps.

First, the development team must identify the expert or experts whose knowledge it wants to tap; next, team members must secure the expert's cooperation. Gaining this cooperation is not as easy as it may seem. The expert must agree to give of his time and his knowledge, both precious commodities.

In addition, top management must be willing to commit the expert's time to the project. This commitment is difficult because the person best suited for the project is usually the person the organization can spare the least in its daily operations. Management must view the sacrifice as a long-term benefit.

Once the development team secures both a willing expert and the support of top management, it sets out to codify the expert's knowledge. A specially trained professional known as a knowledge engineer carries out this step. The knowledge engineer begins by studying texts and otherwise immersing himself in the expert's domain. He then conducts one interview after another with the expert to try to determine how this skilled professional makes his decisions.

This process tends to fatigue both the knowledge engineer and the expert because most experts have trouble explaining why and how they make decisions. Yet, if the project is to succeed, they must articulate the subconscious rules of thumb, acquired instincts and gut feelings that the expert follows in his work. The expert and the knowledge engineer must overcome frustrations and

Interview

Diagnostic problems suited to expert system applications

Donald Waterman is one of the designers of ROSIE, a rule-based expert system language, and the author of A Guide to Expert Systems *(Addison-Wesley, 1986).*

Currently, he is a senior computer scientist at Rand Corp., where his work focuses on the applications of expert systems in government and industry. Previously, Waterman was a research associate in psychology and computer science at Carnegie-Mellon University.

During a recent interview with Computerworld *Senior Editor Janet Fiderio, Waterman talked about advances in expert system technology.*

Where are expert systems now in terms of their potential?

I think they are just at the beginning of their usefulness. Expert systems are really the leading edge of artificial intelligence technology. In the past, AI was confined to universities and classrooms, but with the advent of expert systems, that changed. Industry now sees the potential for using the technology in a cost-effective way. That is what has made the whole idea of expert systems seem so promising to the outside world, beyond academia, that is.

What types of problems are expert systems suited for in industry?

It is hard to point to any particular area that they are better suited for than others. Expert systems started out with an impact on the medical field, therefore it is now fairly well understood how to develop expert systems for diagnostic-type problems. Of course you can have diagnostic-type problems in areas other than medicine. Expert systems have been developed, for example, in electronics and are applicable to most areas in general.

It would not be advisable, however, to try to develop an expert system for a project in a research stage. Even though it could be done, and it might be interesting, the payoff wouldn't be as high as applying it to something that is established.

Is codifiable knowledge then a key to creating an expert system?

You need codifiable knowledge, and you need situations with generally acknowledged experts that agree, to some extent, on reasonable solutions to the problems in that domain.

Can we expect expert systems to be used widely in the workplace in the coming years?

Yes. In fact, I think one of the really interesting uses for expert systems in the workplace is in an area that I call intelligent systems. An intelligent system is an expert system on a chip that is embedded in a piece of equipment. This type of system has quite a number of advantages, one being its location. A typical expert system, say, one used for diagnosing a piece of equipment, has to be brought to the equipment — or the equipment has to be brought to the expert system to be used. Once this happens, then a user uses the expert system to help him or her determine the faults in the equipment.

Now with intelligent systems, an expert system on a chip is embedded within the equipment; it is always there. It can continuously monitor the use of the equipment via sensor data throughout the lifetime of the equipment. It has much more information available to it than a system that is brought in only when trouble has occurred. An intelligent system has a whole history of what the equipment has been doing. In fact, it has the potential to predict when faults are going to occur and notify equipment users that perhaps modules should be replaced, even before the faults are serious enough to be noticeable to the outside world.

Do expert systems have any advantages as a source of expertise in the workplace?

There are certain advantages. One advantage is that the expertise that is built into an expert system is generally very high-level expertise. This expertise is very scarce and costly in human terms. Once you have modeled human expertise in an expert system computer program, you can economically duplicate that program and have, in effect, that program in multiple locations solving problems in parallel all at the same time. So more expert knowledge is available.

Do expert systems have any disadvantages?

Yes. There are a number of disadvantages. Probably the most prominent disadvantage is the fact that expert systems are not as creative as real experts. They are not as adaptive. It is difficult at this time for expert systems to learn from their environment or to adapt to new situations the way human experts can.

In addition, it is more difficult for expert systems to understand their own limitations so that they won't attempt a problem that they really are not qualified to solve. A real expert can do this quickly. Real experts will say, 'That is not within my area of expertise, and I will refer you to someone who can solve this.' Now this isn't to say that expert systems can't be designed to do this just because the current crop of expert systems are not designed to do this.

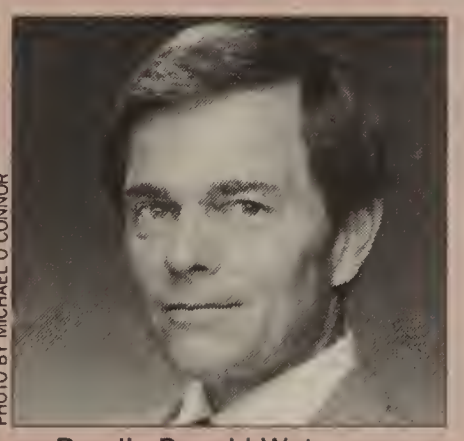

PHOTO BY MICHAEL O'CONNOR

Rand's Donald Waterman

> ***'Managers have to start becoming familiar with the technology just to stay abreast of the competition.'***

Do you have any recommendations for DP or MIS managers concerning expert systems?

I think managers should start considering expert systems right away. In a sense, they really have no choice. They have to start becoming familiar with the technology just to stay abreast of the competition.

Will expert systems provide corporations with the competitive edge that they need to survive?

Absolutely. In fact, it is probably worse than that. It is probably the other way around. Without expert systems, they will lose the competitive edge, and they won't survive.

If all of this is true, where do human experts come in? Should they work in conjunction with expert systems? Will they monitor expert systems to make sure that their knowledge base is pure? Exactly what will their functions be?

Human experts are very high level. They will help with the development of expert systems. The intermediate-level experts and lower level experts all the way down to the novice users will make use of these expert systems. Many of the expert systems will act in a consulting mode. They won't just solve problems; they will solve the problems in conjunction with the user, particularly in areas where the problem domain is of critical importance, for example, where human life is involved or large amounts of money or property are involved. ■

mental blocks to create a comprehensive and tangible outline of what comprises expertise.

After the two professionals create the outline, the knowledge engineer translates it into computer code, usually in LISP. The knowledge engineer can, however, use any language — from Basic to C — with which he is comfortable. The knowledge engineer then builds a structure known as the inference engine, which can correlate the outline's general rules to more specific pieces of knowledge that will get added to the system later.

In the next step, the knowledge engineer interviews the expert to uncover these specific pieces of information. He then enters the information into the system as a collection of facts, referred to as the system's knowledge base.

> ***An organization that needs to solve a one-of-a-kind problem or keep its advances secret has little choice but to build from scratch.***

Combined, the inference engine and the knowledge base form the complete expert system. Once the two parts are in place, the expert and the knowledge engineer refine the system by running tests under hypothetical and actual conditions. They then compare the expert system's solutions with those that the expert comes up with on his own.

Elapsed time from the beginning of a custom development project to the implementation of the expert system often tops two years. Combined costs for knowledge engineering, software development and hardware range from a few hundred thousand dollars to upward of $3 million.

Expert system shells. The time and money an organization must spend on custom development pay off handsomely for solving business problems marked by either complexity or sensitivity. An organization that needs to solve a one-of-a-kind problem or keep its advances secret, in fact, has little choice but to build from scratch.

But very few people outside university laboratories and AI-specific companies are capable of creating expert systems from scratch, and many firms cannot justify the expense of hiring an outside consultant to do the work. Fortunately, vendors offer expert system development tools that allow businesses to test the waters without investing hundreds of thousands of dollars in custom development.

These tools — variously known as shells, inference engines, frameworks and structures — can cut system development time by one-third to one-half. They typically cost between $10,000 and $80,000.

All shells operate on the same time-saving principle: They prepackage an expert system's inference engine, freeing the knowledge engineer from the burden of creating this structure from raw code. To develop a complete expert system, the knowledge engineer need only add a specific knowledge base to the generic shell structure.

The process is much like that of adding a specific liquid to an empty cup. Once the liquid pours in, the cup becomes a new entity — a cup of coffee, perhaps, or a cup of tea.

By the same token, when developers fill an expert system shell with a specific base of knowledge, the shell becomes a new entity — a tax advisor expert system or a fuel tank maintenance expert system, for example.

Most shells are designed for implementation under a LISP environment on specialized hardware from DEC, Symbolics, Inc., Xerox Corp., Texas Instruments, Inc., Lisp Machine, Inc. and other players in the AI market. The following are the top development tools for these machines:

- The Knowledge Engineering Environment from Intellicorp.
- The Automated Reasoning Tool (ART) from Inference Corp.
- S.1 from Teknowledge, Inc.
- The Knowledge Engineering System (KES) from Software Architecture and Engineering, better known as Software A & E.
- Knowledge Craft from Carnegie Group, Inc.

Other vendors offer shells that run under general-purpose DP architectures. Their various offerings bring expert system development capability to almost every popular machine — from DEC's Microvax to IBM's Personal Computer.

Different shells require varying levels of programming ability, but the most simple are quite easy to use. After just a few hours of experimentation, novices can get results out of most microcomputer shells.

Expert system application packages. In the last quarter of 1985, the artificial intelligence industry gave birth to a new market, one that will go even further than the shell market has gone toward enticing businesses to develop expert systems. That market is one of expert system application packages — off-the-shelf expert systems that are, quite literally, ready to run.

Expert system application packages will attract business users because of the great savings in development costs and time that they make possible. Outside of an initial

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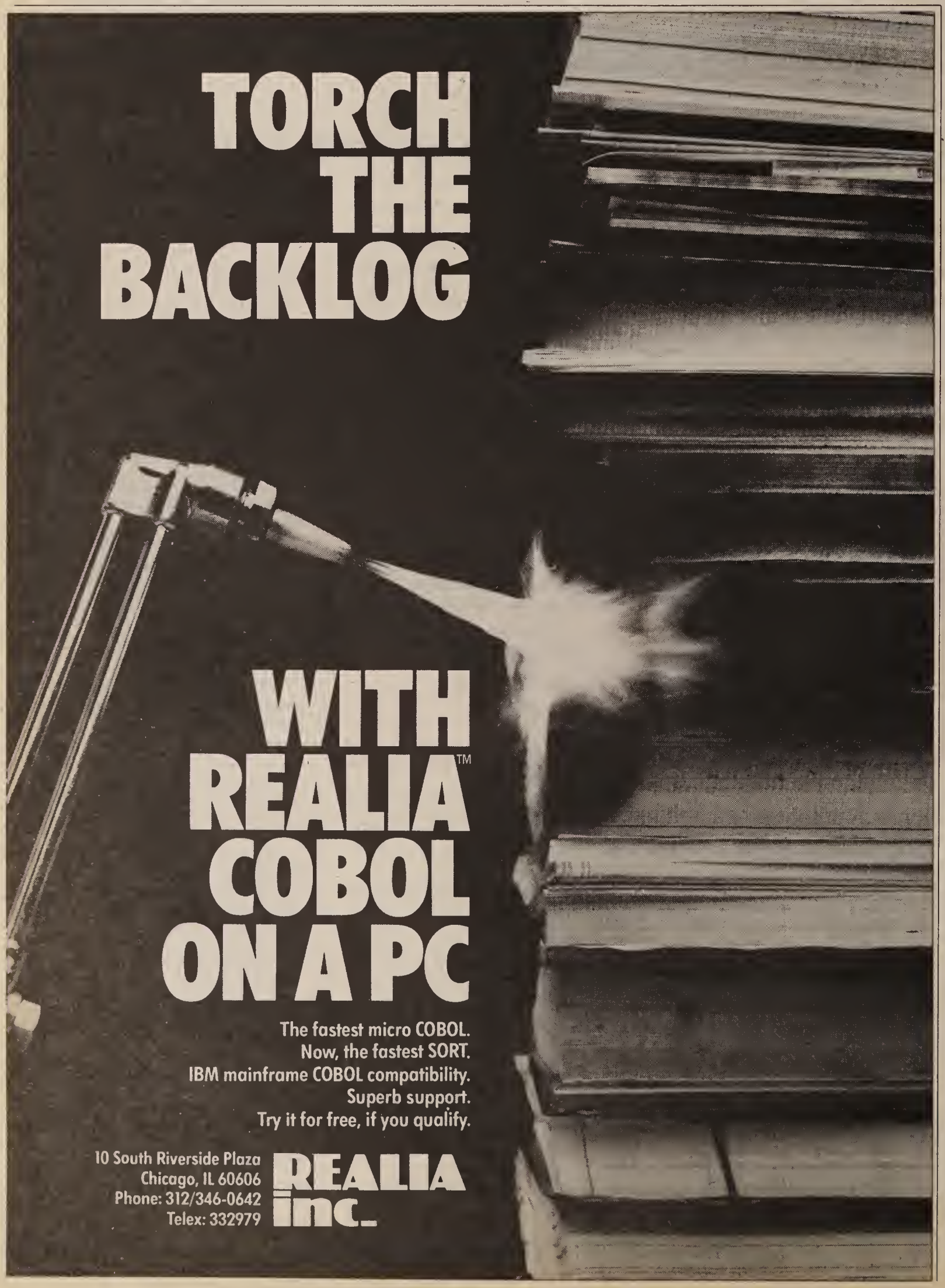

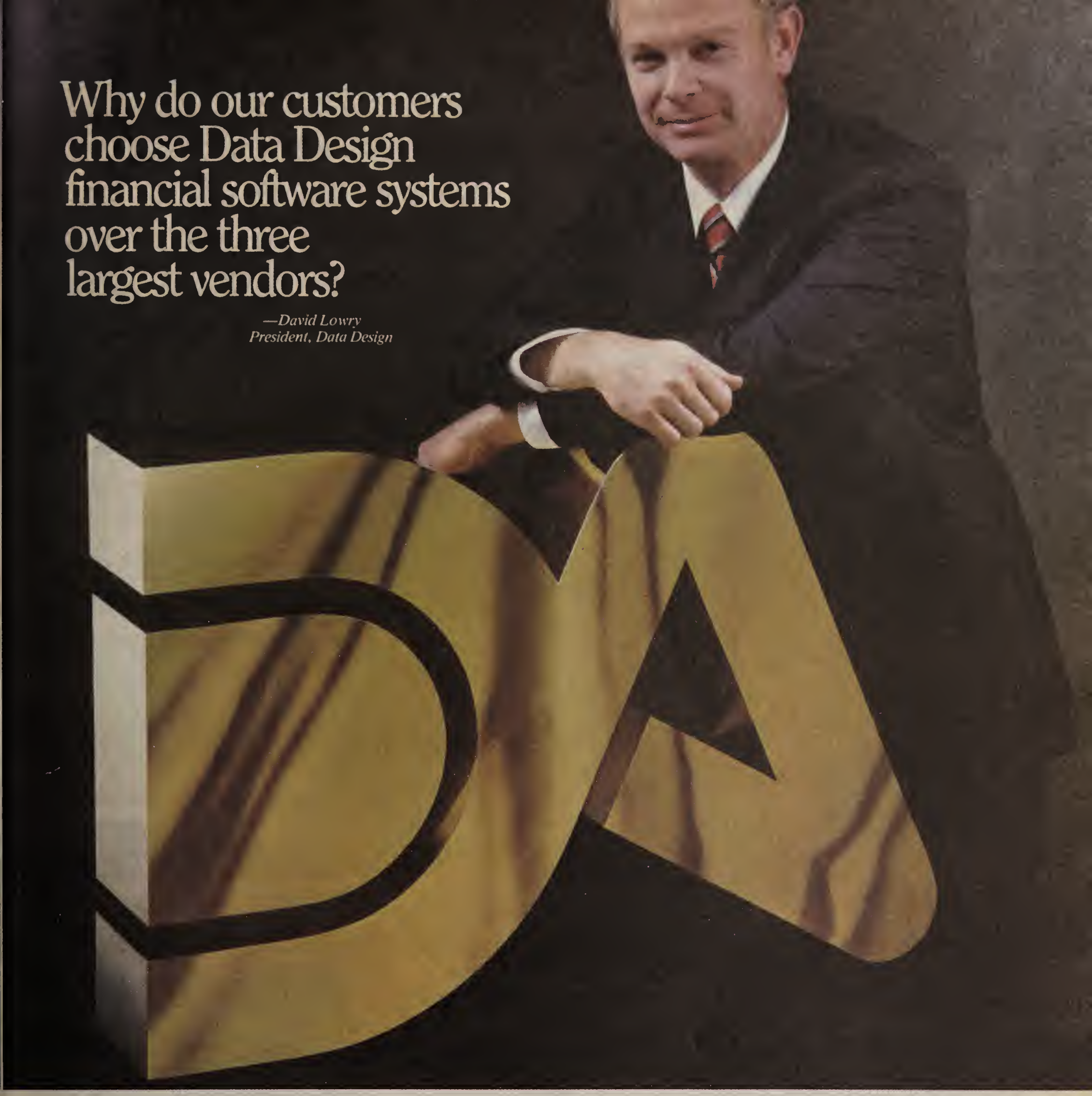

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Choice of technology guides thrust of expert system effort

By HENRY ERIC FIRDMAN

Before an organization makes its initial foray into expert system development and use, its managers must make a conscious choice among expert system technologies.

The decision to rely on rule-based technology, frame-based technology or a hybrid of the two — the three choices currently available to managers — determines which specific tools the organization can use. More important, the choice of technology determines the overall direction of the organization's efforts.

Roughly speaking, reliance on rule-based technology will give an organization the ability to solve only clearly defined, stand-alone problems. The underlying assumption is that the skills an expert uses to solve a given problem can be extracted effectively and efficiently as rules of thumb and incorporated into an expert system through the process of knowledge engineering.

Reliance on frame-based technology, on the other hand, will allow an organization to solve a variety of problems — even problems that have yet to be recognized — within a general domain of knowledge. The underlying assumption here is that after accumulating a critical mass of problem-independent knowledge about a given domain, a knowledge-based system will become capable of solving problems within that domain.

Reliance on hybrid technologies, of course, will provide a combination of rule-based and frame-based abilities. Hybrid systems rest on the assumption that both specific rules of thumb and general domains of knowledge come into play when an expert solves a problem.

Strategic planning for expert system use depends so strongly on an in-depth understanding of the different technologies that no MIS manager charged with expert system development can afford to remain ignorant.

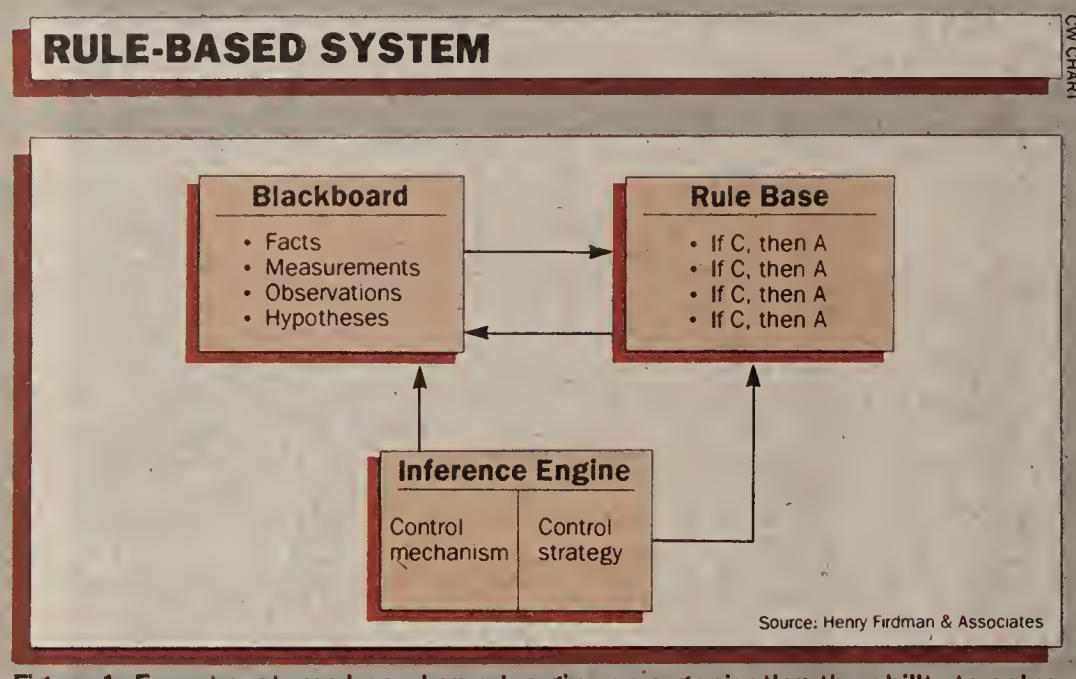

Figure 1. Expert systems based on rules give an organization the ability to solve clearly defined, stand-alone problems.

Rule-based systems. Figure 1 shows the generic architecture of a rule-based system and its three major components: a rule base, a blackboard and an inference engine.

The rule base is a collection of statements, each in the form, "If C, then A," where C represents a condition and A an action. In an expert system that helps an MIS manager decide which of his employees to send to a given trade seminar, for example, the following rule might apply: If the seminar location is less than 250 miles from an employee's home office, and the employee shows an interest in the seminar's subject matter, then send the employee to the seminar.

The blackboard is a collection of items that, taken together, describe the state of the world in which the expert system operates. It can include a mixture of facts, measurements, observations and similar elements. In the example above, the blackboard might include these relevant items: Joe Smith works in the Boston office; Boston is 210 miles from New York; Joe Smith shows an interest in AT&T's Unix; "Unix in the DP Shop" is a seminar that takes place in New York.

The inference engine, the only procedural part of a rule-based system, is the part that actually solves any given problem. It typically consists of two parts: a control mechanism, which uses a predetermined strategy to search through the blackboard and the rule base for solutions to a given problem; and a control strategy, which imposes a set of constraints on the control mechanism to keep it from wasting time on stray leads.

Commercial development tools for building rule-based expert systems typically use one of two predetermined strategies, forward chaining or backward chaining, to guide their control mechanisms' searches.

Forward-chaining control mechanisms begin with a premise and look through the rule base and the blackboard to find possible solutions. These mechanisms set out to answer the question, "What can be inferred from all the elements of the blackboard by using all the rules from the rule base?"

To answer this question, a forward-chaining control mechanism matches the conditional part (C) of every rule against all the elements on the blackboard. The action part (A) of any rule that matches the elements gets added to the blackboard as a newly inferred fact. The process continues until the control mechanism can make no further inferences.

A development tool called OPS5, developed at Carnegie-Mellon University, makes use of the forward-chaining method. Organizations can obtain versions of the tool from different vendors for use on a number of common hosts. Expertelligence Corp. offers ExperOPS5 for the Apple Computer, Inc. Macintosh; Artelligence, Inc. offers OPS5+ for the IBM Personal Computer and a number of Unix processors; and Digital Equipment Corp. offers OSP5 for its VAX-11/780.

Backward-chaining control mechanisms begin with a tentative solution (a hypothesis) and look through the rule base and the blackboard to find justifications for that solution. These mechanisms set out to answer the question, "Can the given hypothesis be justified by the elements of the blackboard by applying the rules from the rule base?"

To answer this question, a backward-chaining control mechanism matches the hypothesis against the action part (A) of every rule. The conditional part (C) of any rule that matches the hypothesis gets tested against the blackboard. Any match of a rule condition to a blackboard element serves as justification for the hypothesis. All mismatches point out other possible hypotheses, which the control mechanism tests in turn.

Tecknowledge, Inc. offers two backward-chaining tools, S.1 and M.1, for use on a large number of machines. S.1 runs on the DEC VAX-11/780 and various LISP- and Unix-based machines. It will soon work within the Ada environment as well. M.1 runs on the IBM Personal Computer.

Frame-based systems. Unlike rule-based expert systems, which stay within defined architectural boundaries, frame-based systems are dynamic entities; a frame-based system changes shape as its constituent parts — its frames and slots — interact.

Frames are collections of knowledge that describe various concepts by listing each concept's features and its relationships to other concepts. Slots are more specific pieces of information, typically values and procedures, that attach themselves to the frames and further describe the concepts therein.

Figure 2, which depicts a portion of a frame-based system designed to describe different types of events, illustrates the two components and their relationships to each other. This system's knowledge base consists of events and their characteristics (subject matter, objectives, duration, location, instructor, date and attendees). Each diamond on the diagram represents a frame, and each set of brackets represents a slot.

The diagram also illustrates the general structure of a frame-based system: a collection of frames, each of which defines a concept from a different point of view or at a different level of abstraction. In Figure 2, the frames Seminar, One-Day-Events and Events-In-New York describe the concept "events" from different points of view; the frames Seminar-Unix and Seminar-1 describe it at different levels of abstraction.

Each frame, moveover, relates to each adjoining frame in a hierarchy of classes and subclasses. Seminar, for example, is a subclass of Event, as are One-Day-Events and Events-In-New York. Seminar-1, then, stands as an instance of each of the five classes directly and indirectly above it.

An important control mechanism known as inheritance (represented in the diagram as the arcs that connect the frames) ensures that

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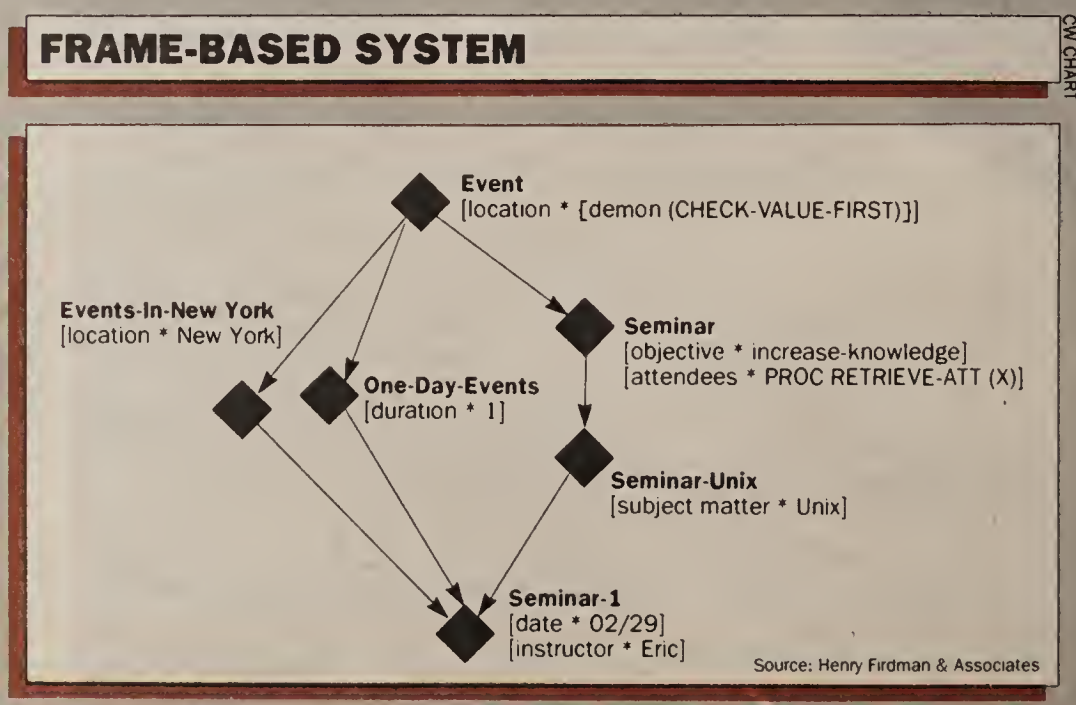

Figure 2. Expert systems based on frames let an organization solve many problems within a domain — even problems that have yet to be recognized.

Firdman is the founder and president of Henry Firdman & Associates, a Lexington, Mass., company engaged in research, education and consulting in artificial intelligence and expert systems.

Continued from page 46

purchase cost, these applications require almost nothing of a firm's DP management — neither time nor money.

End users merely define some parameters, and the programs are ready to run. An organization's programmers need not get involved at all; vendors typically provide all necessary maintenance and support. The end user must make sure, however, to input new parameters as the business environment changes. Otherwise, the system will not stay up-to-date.

The market for mainstream expert system application packages took a major leap a few months ago with the introduction of two new products: Planpower, from Applied Expert Systems, Inc., and the Financial Advisor from Palladian Software, Inc.

Both packages are complete expert systems that help companies plan and control finances. Both are impressive in their scope, but their initial cost may drive prospective users away.

Planpower, designed as an assistant for financial planners, sells for $45,000. That price includes software and a Xerox 1186 workstation on which to run it. The program is written in LISP. Financial Advisor, aimed at corporate controllers, costs $46,000 without hardware. (Prices for multiple copies are substantially lower.) Like Planpower, it runs on LISP machines.

Other vendors sell expert system applications within niche markets:

- Fountain Hills Software, Inc. sells Fair Cost, a cost-modeling program for semiconductor components.
- Sterling Wentworth Corp. offers Planman, a financial planning expert system targeted at tax advisors.
- Ion Technology Services, Inc. markets Diagnostic Troubleshooter, an expert system for the maintenance of specialized semiconductor production equipment.

The niche applications listed above run on microcomputers and cost between $495 and $20,000. Persoft, Inc., another player in the expert system niche market, sells a mainframe-based application. Persoft's More, an expert system that qualifies names on mailing lists for direct mail campaigns, costs $375,000.

Eventually, expert system applications will provide organizations with all sorts of expertise that they cannot find in-house — everything from financial planning to factory scheduling. Certainly, companies that are not equipped to invest heavily in knowledge engineering will find these packages very attractive.

Eye on the future

Today, the expert system market is worth approximately $75 million. Government and research efforts at custom design account for most of the figure, as much as two-thirds. Fortune 500 companies' development efforts make up most of the remaining one-third, and these companies primarily use shells. The applications market is too new to generate figures that indicate market penetrations.

The greatest obstacle to more widespread use of expert systems lies in the initial development environment. A huge percentage of expert system work proceeds under LISP, but very little traditional computing gets done in this language.

The jump from LISP to a central computing environment is not an easy one; at times, it is impossible. Usually, organizations must take the expert systems they develop under LISP and rewrite them in a language that is either more portable or more efficient.

For now, many companies employ their LISP machines for both development and delivery. But the expense of running developed systems on LISP machines makes this approach a bur-

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MITCHELL J. HAYES

A SAMPLING OF REAL-WORLD EXPERT SYSTEMS

Medicine
Mycin diagnoses and prescribes treatments for meningitis and bacteremia infections. The Stanford University Medical Experimental Computer Facility developed it in the mid-1970s.

Training
Steamer teaches naval officers, through simulation, the techniques needed to run a steam propulsion plant similar to those used in many ships. The U.S. Navy Personal Research and Development Center developed it in cooperation with Bolt, Baranek and Newman, Inc.

Computer Systems
Xcon configures VAX-11/780 computers on a daily basis for Digital Equipment Corp. DEC and Carnegie-Mellon University developed it and implemented it in June 1971.

Chemistry
Dendral estimates the molecular structures of unknown compounds by analyzing mass spectrographic, nuclear magnetic resonance and other data. Stanford University developed the system.

Engineering
Delta uses diagnostic strategies to identify and help maintenance workers correct malfunctions in diesel electric locomotives. The research and development center of General Electric Co. developed Delta.

Geology
Dipmeter Advisor estimates the subsurface geological structure of an area by analyzing dipmeter logs and other pertinent geological data. Schlumberger-Doll Research developed the program.

Expert systems have been developed here in the U.S. for many applications. The above list is a representative selection of those systems.

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Custom-developed expert systems offer strategic but costly

By JAMES R. DAVIS

From a cost-estimate point of view, custom expert system development resembles typical custom software development, with one twist. Expert system development is far more expensive.

Two factors serve to keep costs high: the scope and depth of expert system projects and the wages of the people involved.

Most organizations turn to custom development projects only after they identify artificial intelligence as a strategic weapon for attacking a problem area in which other computer science techniques have come up short.

Such projects are necessarily broad in their scope and depth. Developers typically tap the knowledge of a number of experts within the targeted domain and rely on a complex array of rule- and frame-based technologies. Managers expect the finished systems to improve business a great deal.

AI programmers, knowledge engineers and other expert system professionals command a high price — and get it — because of the scarcity of AI expertise in a market that demands more and more.

A good LISP programmer typically earns an annual salary of between $40,000 and $60,000. Trainees' salaries are lower, but an organization cannot expect a novice to come up to speed for a year.

Consultants cost more than in-house staff members, but they give their clients access to top-flight personnel and require no capital investment or long-term commitment.

No matter who does the work, an expert system development project costs from $150,000 to $200,000 for each man-year of effort. These personnel costs take into account wages, benefits, hardware and software support, administrative costs and incidentals like travel.

Any organization that plans to build an expert system on the scale that a strategic project requires should expect to devote between 10 and 16 man-years of effort. Because each man-year costs between $150,000 and $200,000, the organization should budget between $1.5 million and $3.2 million.

> ***Most organizations turn to custom development projects only after they identify artificial intelligence as a strategic weapon for attacking a problem area in which other computer science techniques have come up short.***

Most projects span between 1¾ and 2½ calendar years from the time an organization identifies a likely expert system project to the time a prototype system is ready for testing.

The time and resources an organization must commit to a large-scale expert system development project divide neatly across three stages of development: the proof-of-concept stage, the demonstration stage and the prototype stage (see chart).

Resource commitment is proportionate, of course, to the number of components being built, the complexity of those components and the level to which each is being developed.

Proof of concept. The goal at this stage is to develop enough essential components to determine whether or not AI techniques can provide an appropriate solution to the problem at hand. To make that determination, the development team works through two steps.

First, developers conduct a feasibility study, either as a stand-alone project or as part of a corporate strategic planning exercise. They check to see that the proposed application will benefit from expert system technology then suggest an appropriate scheme for representing the system's knowledge structure and a suitable control mechanism for driving its operations.

Typically, two people — a knowledge engineer and a programmer — work on this step for between four and six calendar weeks.

Second, the knowledge engineer and the programmer build a small section of the system to develop

Davis is a senior consultant at Arthur D. Little, Inc.'s Artificial Intelligence Center in Cambridge, Mass. The AI center designs and develops knowledge-based systems for business and industry.

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and test the proposed knowledge representation scheme and control logic. They develop a user interface but add only those features needed for running feasibility tests.

This rudimentary development and testing step is crucial to the proof-of-concept stage because it is the only way to determine a project's technical feasibility. The process generally adds an additional three or four calendar months to the proof-of-concept stage.

An additional programmer may join the team at this point to code the user interface while the original programmer works with the knowledge engineer to code the system's knowledge structure and control logic.

CW Chart

CUSTOM DEVELOPMENT LIFE SPAN*

Stage	System Components	Duration	Level of Effort	Cost
Proof of Concept	Small, simple knowledge base; skeletal control logic; skeletal user interface; operable by developers; no documentation	4 to 6 months	1 to 2 man-years	$150,000; to $400,000
Demonstration	Medium-size knowledge base of moderate complexity; skeletal control logic; rough user interface; operable by trained experts; internal documentation	4 to 6 months	1 to 2 man-years	$150,000 to $400,000
Prototype	Multiple, large knowledge bases; complete, complex control logic; complete user interface; operable by trained users; design documentation	12 to 18 months	8 to 12 man-years	$1.2 million to $2.4 million
TOTAL RESOURCE COMMITMENT		20 to 30 months	10 to 16 man-years	**$1.5 million to $3.2 million**

* Figures based on Arthur D. Little, Inc.'s experience in developing more than 30 large-scale, strategic knowledge-based systems, typically for Fortune 500 companies.

Source: Arthur D Little

Large-scale custom development projects require 10 to 16 man-years of effort and $1.5 million to $3.2 million.

Demonstration. This stage encompasses two main goals: to flesh out the partial system's knowledge base and to develop the overall user interface fully enough so that an expert who understands the subject matter can operate the system. Developers may also want to make the system's knowledge representation scheme more complex or integrate the demonstration system into an existing system.

All efforts at this stage proceed according to a central motive: Developers rely on demonstration systems to convince top management to invest in a full-blown system.

The time and money devoted to developing the demonstration system tend to equal the time and money devoted to the proof-of-concept stage. The number and type of professionals involved varies according to the system's design and purpose.

Prototype. The goal at this stage is to develop a full working model of the expert system, a model that target users can operate on their own after they have been trained to do so. Developers expand the knowledge base to encompass all facets of the system's subject matter; they add still more complexity to the control logic; and they complete the user interface and produce comprehensive design documentation.

Obviously, the prototype represents a large jump from the demonstration system. An organization might wish to build its development plans around intermediate steps, each targeted toward an important milestone (the completion of the user interface, for example, or the completion of the control logic).

Development of a prototype typically spans between one and 1½ calendar years.

Even after an expert system is brought to the prototype stage, developers face a tremendous load of work. They must thoroughly verify, validate and debug the system and must polish up its documentation. These steps typically consume at least as much time and money as the proof-of-concept, demonstration and prototype stages combined. Often, they require even more. ■

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Micro-based systems pave low-cost route to commercial AI

By BEVERLY CRONIN

Microcomputer-based expert systems represent an inexpensive route into commercial applications of artificial intelligence technology.

Not too long ago, managers interested in exploring expert system applications needed a mainframe, a minicomputer or a special LISP machine, any of which would have cost tens of thousands of dollars at the very least. They also needed very expensive software and equally expensive programmers and knowledge engineers.

Today's managers can get by with a microcomputer and a micro-based expert system shell, and they can explore the field on their own. Most shells cost between $500 and $5,000.

On a diminished scale, expert systems built on micros with inexpensive shell software offer much the same benefits as their larger counterparts. They archive rare knowledge, free up experts to work only on really tough problems, spread expertise around and promise to reduce operating costs.

Saving money is the ultimate business end, but the beginning for every business involves experimentation that breeds technical familiarity. The key to success is for system developers to choose an appropriate application for their initial experiments.

"Micro-based expert systems are viable entities in business if you get the right problem," according to Esther Dyson, editor and publisher of "Release 1.0," an industry newsletter. "You'll find them," she said, "where information can be easily crystallized into rules."

In this respect, micro-based systems are no different from those developed on mainframes and minis. The delineations that mark an application as being appropriate for a micro-based system are the application's size, or the amount of memory space it will require, and the scope of its domain, or the intricacy of the application's subject matter.

The application size a micro expert system can support depends on the specific expert system shell being used. Commercially available shells typically support between 250 and 2,000 rules, although some are much bigger.

A domain is a good candidate for conversion to an expert system — micro or otherwise — if it meets four criteria, according to Patrick H. Winston, professor of computer science and director of the AI laboratory at MIT:

- No common sense is needed to solve the problem.
- The problem takes about one hour for a human expert to solve.
- An expert within the organization is committed to the idea of developing the expert system.
- There is plenty of public domain knowledge with which to create the knowledge base.

Beverly Thompson, who operates the New York consulting firm Micro Expert Systems, has a succinct method for recognizing problems that a micro-based system can solve. Thompson pinpoints appropriate applications by asking whether a novice could solve the problem after a half-hour, give-and-take telephone dialogue with an expert.

Other authorities suggest different means for identifying applications. Carl Wolf, president of Gold Hill Computers, Inc., a Cambridge, Mass.-based AI vendor, said micro-based expert systems make sense for tasks "where you have an army of people doing the same thing" but with different amounts of skill. With an expert system, Wolf said, "you homogenize the delivery of the expertise and raise the level of the expertise overall."

Training time, cost factors

William Harrelson, chief operating officer at Brattle Research Corp., an AI software developer based in Cambridge, considers training time and cost — two key factors to examine when evaluating potential applications. "Micro-based expert systems best solve routine judgment problems, problems for which you might ordinarily train someone for one to two months to do a job and where you have a high turnover," he said.

Jeffrey Perrone of the consulting firm Jeffrey Perrone and Associates, Inc. in San Francisco reinforced Harrelson's guidelines. "Basically, any kind of decision that requires specific information to be used repeatedly and routinely lends itself best to micro-based expert systems," Perrone said.

Once an organization chooses an application, it can proceed with development in almost any way it sees fit. Micro-based expert systems are just emerging as a phenomenon, and their eventualities have yet to unfold on a wide enough scale to force the formation of either tacit or implicit development rules.

Tom Schwartz of Tom Schwartz Associates in Mountain View, Calif., who serves as a consultant to some

Cronin is a free-lance writer based in Fitchburg, Mass.

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users of AI technology, offers only one strong suggestion. "Managers should start with something simple . . . to learn something about putting information into rules," Schwartz said. If the experiment produces nothing of immediate value, it will at least have served an educational purpose; if it produces real benefits, all the better.

Indeed, what started out as a learning endeavor at Travelers Corp., an insurance and financial firm in Hartford, Conn., turned out to be a practical solution for decreasing downtime in a nationwide network of 560 IBM 8100 controllers. Travelers chose the 8100s as a focus for expert system experimentation because the machines posed a problem to troubleshooters on the firm's DP help desk, who had not been trained to diagnose 8100 failures.

"We were trying to learn about AI," said Luther Weeks, assistant director of computer science in Travelers' DP department, "and the particular application we chose was one of the things our help desk staff spent more time on than others."

The controllers failed so infrequently that the firm could not justify training a lot of experts and keeping them around just waiting for a malfunction.

A few 8100s went down almost every day, however, and when one did, help desk staff members had to play telephone tag with affected users and trained experts to solve the problem and bring the controller back up. The controllers typically stayed out of commission for between 30 minutes and two hours.

One of Weeks' DP staff members worked for three months with an IBM Personal Computer and Teknowledge, Inc.'s M.1 expert system shell to develop a system that would diagnose 8100 problems for help desk staff members and cut down on telephone calls and downtime. The system he created, a 70-rule program called DIAG8100, worked as planned.

"The biggest benefit is decreased downtime," Weeks said. Since DIAG8100 went into full operation last May, typical downtime for the 8100s has been between five and 10 minutes.

Unless the DP department creates a system for its own use, as the Travelers shop did, DP staff members are unlikely to get involved in micro-based expert system development. "Typically, we're not seeing the expert systems coming out of the MIS department," Schwartz said. "Typically, it's your expert in various departments, who's gotten tired of answering questions all the time, who is responsible for the system."

Micro-based systems are at the point now where micros themselves were about 10 years ago: They are cropping up in various departments within companies but have not yet been integrated into the overall MIS picture.

As such, few guidelines exist regarding who is to maintain finished systems and ensure that their knowledge bases remain sound.

Thompson explained that, in common practice, an expert system project often has a kind of godfather — someone who has overseen the project from its start — who rules on maintenance issues. ■

For further information

Readers who are interested in learning more about expert system technology and AI business applications may find the following publications and events helpful.

Publications

A Guide to Expert Systems. Donald A. Waterman. Addison-Wesley Publishing Co., Reading, Mass. 1986.

Artificial Intelligence: An MIT Perspective. Editors: Patrick H. Winston and Richard H. Brown. MIT Press, Cambridge, Mass. 1979.

Artificial Intelligence for Microcomputers. Mickey Williamson. Brady Computer Books, Prentice-Hall, Inc., Englewood Cliffs, N.J. 1985.

Expert Systems: A Management Guide. Mike Turner. PA Computers and Telecommunications, Princeton, N.J.

Expert Systems: Artificial Intelligence in Business. Paul Harmon and David King. John Wiley & Sons, Inc., New York, N.Y. 1985.

Events

MARCH 24-27, SINGAPORE — **Artificial Intelligence '86 Conference: AI and its Applications — A State of the Arts Review.** Contact: John Tagler, Elsevier Science Publishers, 52 Vanderbilt Ave., New York, N.Y. 10017.

MARCH 31-APRIL 4, ORLANDO, FLA. — **Third Annual Conference on Applications of AI.** Contact: Janet Houston, International Society for Optical Engineering, P.O. Box 10, Billingham, Wash. 98227.

APRIL 1-4, CHARLESTON, S.C. — **First International Conference on Expert Data Base Systems.** Contact: Donald A. Marchand, Institute of Information Management, Technology and Policy, University of South Carolina, Columbia, S.C. 29208.

AUGUST 11-15, PHILADELPHIA — **AAAI-86 National Conference on AI.** Contact: Lorraine Cooper, American Association for Artificial Intelligence, 445 Burgess, Menlo Park, Calif. 94025.

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Continued from page 50
subclasses and instances inherit the features and relationships of their superclasses.

Because of inheritance, the expert system illustrated in the diagram understands not only that Seminar-1 takes place on Feb. 29 and is taught by Eric but also that it increases knowledge, lasts for one day, covers the topic of Unix and is held in New York.

Frame-based systems also take advantage of another special mechanism known as procedural attachment, whereby slots' values change as the result of generic procedures.

The slot *attendees* attached to the frame Seminar in Figure 2 illustrates this concept. It differs from the other slots in the diagram in that its value is a variable procedure, PROC RETRIEVE-ATT (X), rather than a fixed statement such as 02/09 or Eric.

> ***Vendors offer impressive hybrid tools for developing systems that combine the features and capabilities of rule- and frame-based technology.***

If an operator substituted the value "seminar" for the value "X," the procedure resident in the *attendees* slot would search the knowledge base and retrieve a list of seminar attendees. The mechanism for inheritance allows this procedural attachment to apply to subclasses of Seminar as well. If an operator requests a list of Seminar-1 attendees, for example, the procedure RETRIEVE-ATT will run with Seminar-1 as its variable and will return with the desired list.

Demons critical

One last feature, a special class of procedures called demons, is critical to a frame-based system's operations. Demons apply operational constraints, protect the integrity of a system's knowledge base and propagate dependencies within a given domain.

The demon CHECK-VALUE-FIRST in the *location* slot attached to the Event frame in Figure 2 is an example. If the system attempted to attach the slot *location * Los Angeles* to Seminar-1, the demon would check first to make sure the location for the event had not yet been defined.

In the case depicted in the diagram, the demon would identify the *location * Los Angeles* slot as being in conflict with the *location * New York* slot, which applies through inheritance to Seminar-1. Noting the conflict, it would prevent the new attachment.

Offer flexible solutions

Until very recently, frame-based systems operated exclusively within research laboratories. Business organizations that are confronted with complex problems and need flexible solutions are beginning to recognize the value these systems can offer, but no vendor currently offers development tools that lend themselves to the creation of a fully frame-based expert system.

Hybrid systems. Vendors do offer impressive tools for developing systems that combine the features and capabilities of rule- and frame-based technology. These hybrid tools bring a new level of flexibility and productivity to the development of large-scale expert systems.

With hybrid development tools, an organization can build an expert system application as an arbitrary mixture of frames and rules. These tools also let developers define rules as frames — a procedure that allows for the representation of extremely complex rule structures.

In addition, the majority of hybrid tools feature object-oriented programming languages, languages with which developers can build rich graphics interfaces between their systems and the systems' users.

Three of the most popular hybrid expert system development tools currently available include the following:

- The Automated Reasoning Tool from Inference Corp.
- The Knowledge Engineering Environment from Intellicorp.
- Knowledge Craft from Carnegie Group, Inc. ■

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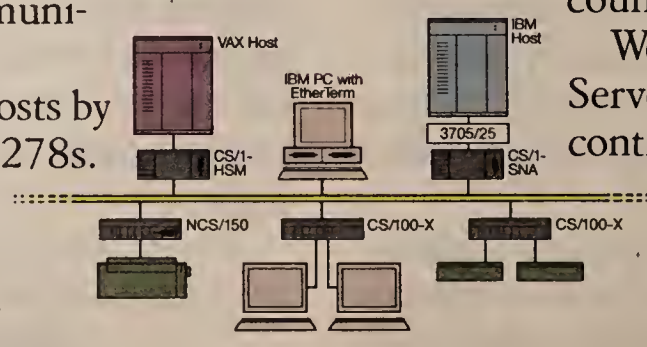

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Continued from page 51

den. Most LISP machines cost between $55,000 and $85,000.

They are cost-effective as engineering workstations but not as general business machines.

To make matters easier for users, a number of AI vendors are now porting their products to C or offering interfaces that were designed to allow finished expert systems to run on microcomputers.

The vendors' efforts vary in scope and are at different states of readiness:

■ Lucid, Inc. is working to establish standard language protocols that allow LISP programs to run on different machines.

The firm currently offers Common LISP for a variety of hardware, including machines from Apollo Computer, Inc., Sun Microsystems, Inc. and Prime Computer, Inc.

■ Intellicorp and Gold Hill Computers, Inc. are developing networks that link LISP machines to machines with other architectures.

Last August, Intellicorp introduced PC-Host, which takes programs developed on LISP machines and downloads them for execution on IBM Personal Computers.

In November, Gold Hill began marketing GC-LISP Network, an Ethernet setup that connects IBM Personal Computers and Personal Computer ATs to each other and to Symbolics LISP machines. With it, users are able to develop systems on the LISP machines and then refine and run them on the microcomputers.

■ Software A & E, Teknowledge and Inference are bringing C versions of expert system shells to market right now.

Software A & E has announced a C version of KES, and Teknowledge has announced C versions of both S.1 and M.1. (a micro-based shell). Inference expects to offer a C version of ART this summer.

Other vendors, notably Texas Instruments and Symbolics, are developing LISP chips, processors that can be embedded in standard computers so users can run LISP programs side-by-side with business applications on their corporate hosts. These chips should come to market sometime in 1987.

Problem unsolved

The problem of connecting corporate computing environments with developed expert systems — those currently in the prototype stage at innovative Fortune 500 firms — remains unsolved. Any vendor that finally succeeds in making development environments compatible with IBM, DEC, Data General Corp. and other real-world machines will find itself incredibly successful.

So what now? Throughout 1986, innovative businesses will bring up expert systems, both as products of in-house development and as results of AI applications packages. And, despite the snail-paced implementation of expert systems into mainstream computing, the future looks quite bright.

> ***Managers in second-tier organizations would do well to keep an eye on advancements that give expert systems immediate practicality.***

Corporate commitment to artificial intelligence seems to be showing genuine results, especially in companies like Hewlett-Packard Co., Sperry Corp., Boeing and Lockheed that have invested in small AI companies in addition to creating in-house artificial intelligence facilities.

Although these large players may enter the AI business as vendors sometime down the road, their current efforts all focus on using expert systems to achieve a competitive edge in existing business concerns.

Managers in second-tier organizations would do well to watch the progress being made by firms on the cutting edge, keeping an eye, especially, on advancements that give expert systems immediate practicality.

In time, as the technology blossoms and more corporations try their hands at development, strategic benefits will arise for those who proceed wisely. ■

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Knowledge of AI structures helps target hardware needs

By DAVID BENDEL HERTZ

Artificial intelligence researchers have devoted several decades to making expert systems viable for business and industry, first by developing specialized software tools and more recently by designing dedicated hardware.

Vendors now offer a variety of dedicated machines for expert system development, and the business world stands to gain. If a company purchases machines well suited to knowledge engineers' needs, it can help these AI professionals work more efficiently and can save itself some money in the expert system development process.

To understand their organizations' hardware requirements for developing and applying expert systems, DP and MIS managers need to become familiar with the programming structures used in AI: specialized languages and expert system shells. These structures determine the hardware requirements that DP shops must meet. They also define the problems and opportunities that the coming generation of AI applications will present to MIS managers.

Languages. The development of an expert system depends heavily on computer language techniques designed to process symbols (words and abstract characters) rather than numbers. Two development languages — LISP and Prolog — best embody these techniques.

LISP consists of operators with which programmers can manipulate lists of "objects," an object being anything to which a symbol is assigned. The language is powerful and modular, and it manages storage space very efficiently for programmers who need to construct large and complex expert systems. John McCarthy created LISP while he was working at MIT in 1958. Since then, it has been the language of choice for AI workers in the U.S.

Prolog's constructs provide expert system developers with an easy means for writing programs that manipulate logical expressions. The language gives knowledge engineers flexibility to choose among problem-solving behaviors and to build from these behaviors an interface that frees end users from procedural concerns.

Alain Colmerauer of the University of Marseilles in France developed Prolog in the early 1970s; it is the main AI programming language in Europe and Japan and is beginning to catch on in the U.S.

Because both languages offer distinct and separate advantages, AI practitioners are starting to use combinations of the two. Some vendors in the U.S. offer hybrid language

Continued on page 60

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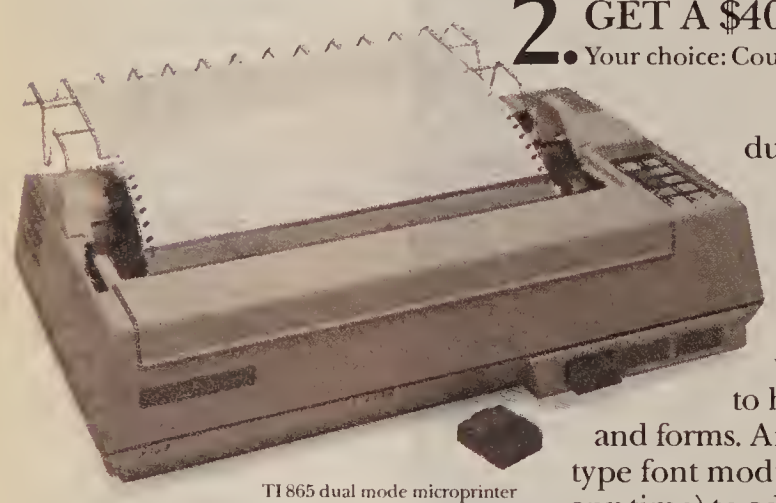

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Current LISP system offerings

Single-user LISP machines offer impressive features, usually at equally impressive prices. What can an organization expect for its money?

The four machines described below are typical of current offerings:

■ **Symbolics, Inc.'s 3670.** The 3670 supports Zeta LISP and Common LISP. It is based on Symbolics' Lbus architecture and communicates via Ethernet.

The machine's random-access memory (RAM) ranges from 2M to 30M bytes, and its disk memory ranges from 474M to 3.5G bytes. The 3670 costs between $100,000 and $350,000, depending on features.

■ **Texas Instrument, Inc.'s Explorer.** Explorer supports Zeta LISP and Common LISP. It is based on TI's Nubus architecture and communicates via Ethernet. The machine's RAM ranges from 2M to 16M bytes, and its disk memory ranges from 140M bytes to 1G byte. Explorer costs between $60,000 and $150,000, depending on features.

■ **Lisp Machines, Inc.'s Lambda.** Lambda supports LISP, Prolog and AT&T Unix. It is based on TI's Nubus and Intel Corp.'s Multibus architectures and communicates via Ethernet. The machine's RAM ranges from 4M to 16M bytes, and its maximum disk memory is 515M bytes. Lambda costs between $80,000 and $250,000, depending on features.

■ **Xerox Corp.'s 1132.** The 1132 supports Interlisp-D. It is based on a proprietary Xerox high-speed bus architecture and communicates via Ethernet. The machine's RAM ranges from 2M to 18M bytes, and its disk memory ranges from 80M to 315M bytes. The 1132 costs between $100,000 and $350,000, depending on features.

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Continued from page 58

products that give users the benefits of both LISP and Prolog.

Expert system development projects that use these languages differ from typical development projects because they involve different program architectures.

MIS and DP managers are familiar with data base and computational programs in which acceptable types of input data have been foreseen and acceptable routes through the program have been predetermined. Expert systems depart from this norm; they are almost totally open ended.

Specialized AI architectures support open-ended operations and save programmers the trouble of working out every possible path through an expert system program. In general, these alternative architectures are known as directed inference systems. Rule- and frame-based systems (see story page 50) are the most popular.

> ***Bandwagon hype notwithstanding, AI is a tough game. If an expert system is to be useful, it is likely to be big — in program size, memory requirements and processor size.***

Shells. Many vendors offer development environments that package a directed inference architecture and a skeletal expert system structure with sets of precoded tools for structuring I/O routines, debugging, editing and performing similar tasks.

Most of these packages, known as shells, consist of LISP or Prolog code, but some are built around conventional languages like Fortran, Pascal and C.

Shells are complete expert systems with generic knowledge of a specific task, but their factual content — their knowledge base — has been stripped out. Users follow prewritten routines for knowledge acquisition and insert facts that are specific to the subject matter around which they wish to build an application.

Development hardware

An expert system that must search through large knowledge bases and rule sets often looks not for an optimum solution to a given problem but for the best solution it can find within a given amount of time. For such a system to be practical, speed is essential.

Dedicated LISP machines, designed specifically to process symbolic information at maximum efficiency, provide the necessary speed. These processors can handle 10 to 20 times more logical instructions per second (LIPS) than general-purpose computers can.

LISP machines feature very high-speed processors, large memories, bit-mapped displays with overlapping windows, communications facilities and specialized keyboards. Most of these machines support a number of interactive, concurrent operating structures, thereby permitting developers to build system specifications and applications programs at the same time.

Such features do not come cheap: A single-user LISP machine can cost more than $200,000, and software packages that allow for efficient expert system development add at least $50,000 to the price an organization must pay.

But knowledge engineers and other AI professionals also come at high prices. A machine that helps them work efficiently can shave development time and can pay off handsomely, especially in development projects that involve large-scale, complex programs.

Four vendors currently compete for user organizations' patronage in the marketplace for single-user LISP machines: Symbolics, Inc., with its 3640 and 3670 machines; Lisp Machines, Inc., with its Lambda line; Xerox Corp., with its 1108 and 1132; and Texas Instruments, Inc., with its TI Explorer.

User organizations can also develop expert systems on mainframes and superminicomputers. In fact, the majority of large-scale expert systems that are operating today run on Digital Equipment Corp. VAX machines.

Software vendors offer a variety of expert system development packages that run on the VAX and other popular processors. But for large-scale projects, development on traditional processors can take two or three times as long as it takes on dedicated machines.

Proceed with caution

Vendors also tout the merits of microcomputer-based expert system development environments, but MIS and DP managers should proceed with caution. Bandwagon hype notwithstanding, AI is a tough game. If an expert system is to be useful, it is likely to be big — in program size, memory requirements and processor size.

Personal computers with less than 1M byte of memory can support nothing beyond a baby expert system. Micros with 3M-byte memories can support rudimentary applications, but most projects require machines with memories of between 5M and 20M bytes.

Even today's powerful AI computers have limitations. Although they process symbolic information at relatively high LIPS speeds, for example, currently available AI computers cannot match the floating-point operations per second (Flops) speeds at which traditional machines process numerical data.

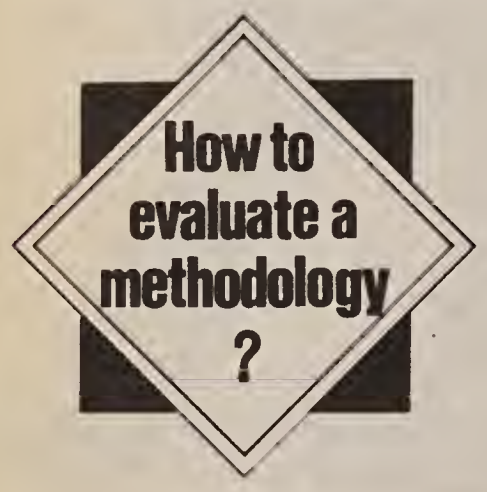
And although dedicated AI machines can run expert system software, they cannot work through problems the same way as human experts do.

Human experts consider many facets of a problem simultaneously and converge on a solution. Machines, on the other hand, branch through different sets of knowledge piece by piece, diverging until they identify a solution.

These constraints are likely to be overcome in the future, when LIPS performance will match Flops performance and when some form of parallelism in hardware and software will allow machines to converge on solutions, much as humans do.

Future machines will also take advantage of laser technology to support enormous data bases of sound and video information, which they will deliver as instructions to end users in place of the textual output that most expert systems supply today. ■

This Executive Report was edited and compiled by Janet Fiderio and Becky Batcha.



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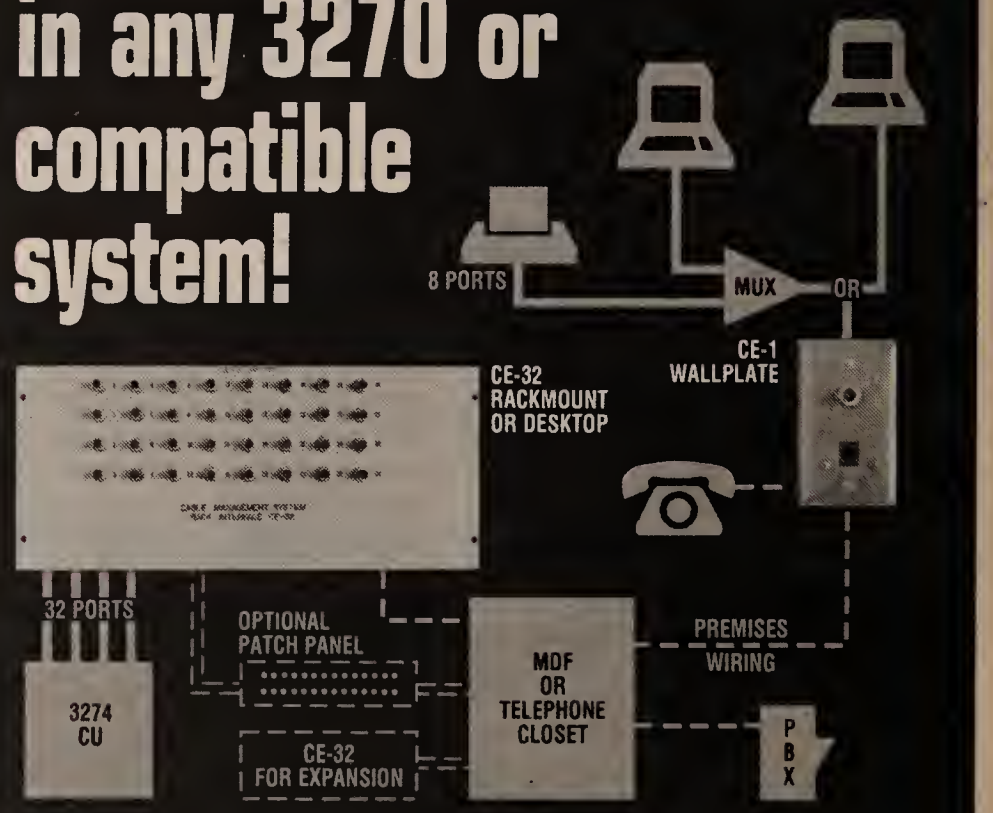

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The Northern Light in Data Communications

An index of 1985 feature articles

In Depth presented 104 stories in 1985 — comprehensive features on complex topics such as universal network services, picking a chief information officer, fourth-generation languages vs. Cobol, Boeing Computer Services Co.'s Technical Office Protocol and IBM's Thomas J. Watson Research Center. We interviewed Mitch Kapor, Bill Gates, Rod Canion, Bobby Inman and Gordon Bell, among others.

In Depth ran articles by several industry authorities, including E. F. Codd on relational data base management systems, Peter Keen, on decision support systems, Girish Parikh on software maintenance, J. Daniel Couger on motivating personnel, Joel Orr on computer-automated design and Ken Orr on the software crisis. And we published excerpts from Meilir Page-Jones' *Practical Project Management*, Charles Wiseman's *Strategy and Computers* and Paul Harmon and David King's *Expert Systems*.

Ten Special Report sections provided dozens of tutorials and applications stories targeting specific computer-related subjects. Seven staff-written Update sections offered focused analyses of the frontiers of technology and how they affect today's DP managers as well as management issues such as hiring, consultant liaisons and stress. Two *Computerworld Extra* magazines each brought together analyses and opinions by leading authors in one particular field.

This index is intended to help readers locate articles on particular topics of interest from last year. To order a back issue, write to Back Issues Department, *Computerworld*, P.O. Box 897, Framingham, Mass. 01701. Issues published on Feb. 11, Feb. 18, May 6 and May 13 are no longer available. Each issue costs $2, prepaid by check made out to *Computerworld*. For multiple reprints of individual articles, call Nancy Shannon, Reprints and Permissions, at (617) 879-0700, extension 304. Reprints are available on 8½- by 11-in. paper in quantities of 100 or more.

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IN DEPTH

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How not to measure programming productivity

The paradoxes of measuring software begin with lines-of-code measures that penalize high-level languages and cost-per-defect measures that rise as quality improves. These and other metric issues must be settled before programming can become a science.

Part 1

By Capers Jones

Scientific progress in every field has been heavily dependent upon the ability to take accurate measurements. Progress in all of the sciences that deal with macro phenomena has been significantly obliged to progress in measurement for progress in the science itself.

To a surprising degree, Fahrenheit's invention of the mercury thermometer; Harrison's invention of the chronometer; and the invention of instruments to measure pressure, voltage, speed, the force of gravity and other natural phenomena have been important precursors to new scientific concepts and sounder theories.

But the measurement of programming has been the weakest link in the whole science of software engineering. When the common metrics used for programming are explored under controlled situations, we discover three major mathematical paradoxes that have completely distorted the history of programming and concealed significant true progress:

Lines-of-code measures penalize high-level languages and often move in the wrong direction as productivity improves.

Cost-per-defect measures penalize high-quality programs and always move in the wrong direction as quality improves.

Ratios established for programming subactivities such as design, coding, integration or testing often move in unexpected directions in response to unanticipated factors.

In addition to these major paradoxes, other measurement problems must be overcome for programming to achieve the level of a science. The six most significant problems have been the following:

■ Failure to define the counting rules for source code statements or lines of code has introduced errors of more than an order of magnitude into many published reports on both productivity and quality.

■ Failure to define the scope of effort actually included in productivity analyses has introduced errors of more than two orders of magnitude in many published reports on productivity.

■ Peripheral and support activities for programming projects, such as documentation, management, training and travel, have been underreported and largely unmeasured. In some cases, there are not even any metrics defined for the activities.

■ There has been a blurring together of the concepts of economic productivity (for example, goods or services produced per unit of labor and expense) and common productivity (such as finishing a task as rapidly as possible). This has caused significant misunderstandings and has caused many measurement reports to focus on code development rather than on economic factors such as products delivered.

■ Some of the most significant factors that affect quality directly, and productivity indirectly, are still intangible and hard to quantify and are underreported. For example, the physical office environment is seldom evaluated as a productivity factor.

■ The two elements of programming maintenance are the addition of new functions to existing programs and the repair of defects in existing programs. These two concepts have been blurred together, with the result that the costs of the two separate activities are not clearly distinguished.

Of all the issues that must be dealt with for programming to become a science, measurement is the most fundamental and the most important. Each of the major problems must be clearly understood for progress to occur. When they are understood, then it is possible to consider measurements that will be accurate and reliable.

Since the programming industry began, the single most widespread assumption about productivity has been that improving software productivity means augmenting the ability to write

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Lines of code as a productivity indicator

	Assembler	PL/I	APL
Source lines	100,000	25,000	10,000
Activity in person-months			
• Requirements	10	10	10
• Design	30	30	30
• Coding	115	25	10
• Documentation	20	20	20
• Integration/testing	25	15	10
Total person-months	**200**	**100**	**80**
Lines of source code per person-month	500	250	125
Total cost	$1,000,000	$500,000	$400,000
Cost per source line	**$10**	**$20**	**$40**

Figure 1

lines of source code at a faster rate.

Another assumption has been that high-level languages improve software productivity. However, if productivity is measured in terms of lines of source code produced per unit of time, then the most significant paradox in the programming industry is encountered: High-level languages will tend to cause lines-of-code production rates to get smaller rather than larger. This retrograde movement is directly proportional to the level of the language, and the highest level languages will have the lowest production rates when a complete development cycle is measured.

Failure to understand this paradox and failure to deal with it when estimating is the largest known problem in measurement and estimating in the software engineering world. The paradox can be illustrated by three examples involving functionally identical programs that are written in assembler language, in PL/I and in APL, respectively. Assume that programming labor costs are constant at $5,000 per person-month.

Observe in Figure 1 the impact of the paradox. While economic productivity improves significantly and total costs decline from $1,000,000 to only $400,000, cost per source line goes up 400%, and lines of code per programmer-month decline from 500 for assembler language to only 125 lines per programmer-month for APL.

The reasons for the paradox are that many of the activities of programming development, such as documentation, are not really affected by the programming language used. When a typical large software project is analyzed, over half of the total effort will go to tasks that are not affected by the choice of programming language.

This paradox is based upon a classic industrial phenomenon. When a manufacturing process has a high level of fixed costs, and there is a decline in the number of units produced, the cost per unit will go up. Programming development also has a significant amount of costs that are either fixed or, at any rate, inelastic and not affected by source languages.

When projects written in high-level languages are compared with projects written in assembler language, these fixed or inelastic costs become increasingly significant, and they drive up the cost per source line and drive down the lines of code per unit of time.

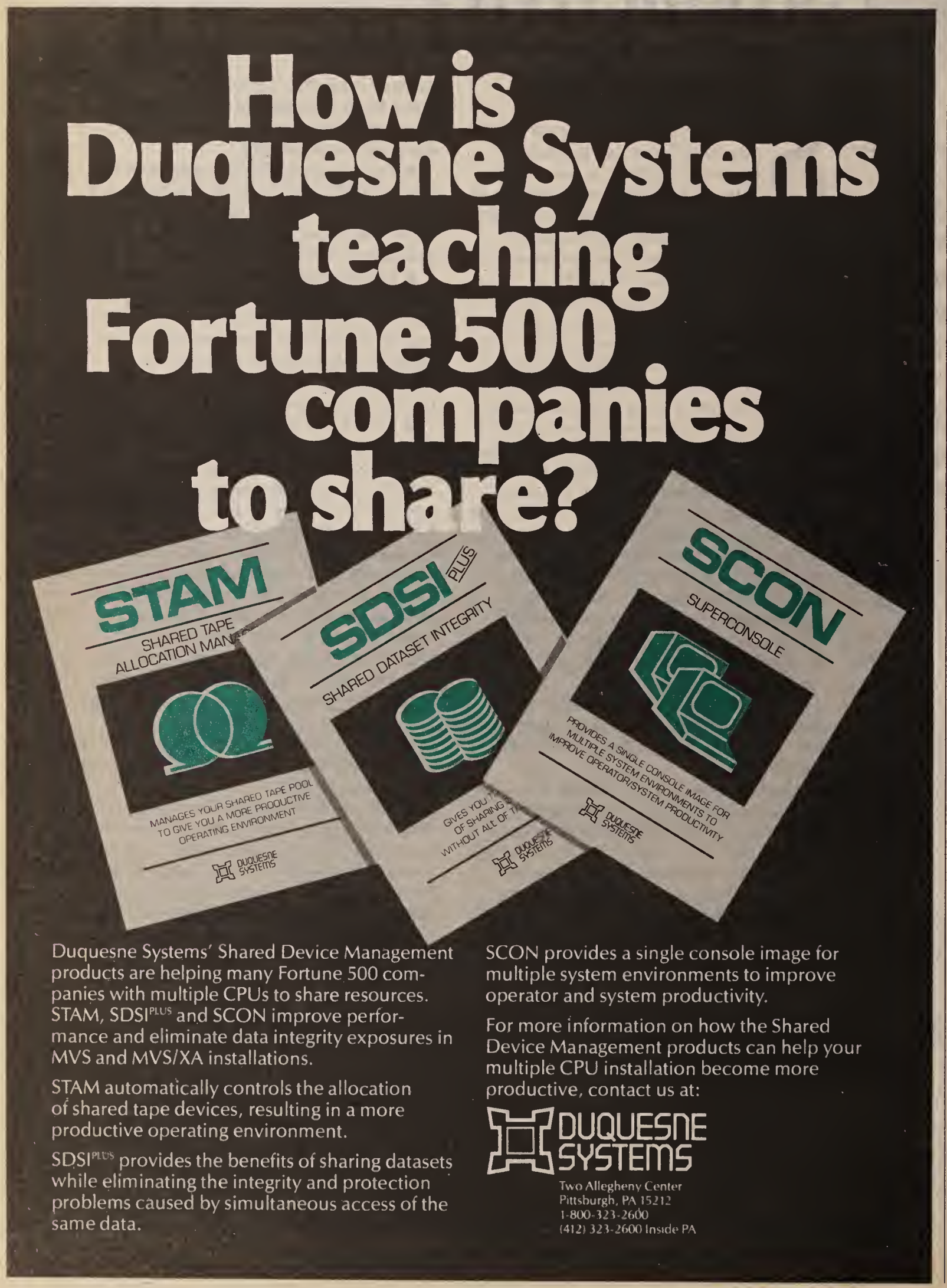
Lack of clear distinction

This paradox also highlights a major issue: the lack of a clear distinction between economic productivity and common productivity. In standard economic theory, productivity is defined as the amount of goods or services produced per unit of labor or expense. For programming, economic productivity would mean the functions delivered to users per unit of labor or expense. A line of source code is neither goods nor services, and hence, it is not an economic unit of measure.

The lines-of-code paradox is made more troublesome by the fact that high-level languages actually do improve coding speed. Note in the assembler language example that coding alone proceeded at a rate of 870 lines per month, while the PL/I and APL versions proceeded at a slightly faster rate of 1,000 lines per month. Yet this increase is overshadowed by the noncoding tasks that are always part of programming development and which have a tendency to act like fixed costs when an entire development cycle is analyzed.

When the paradoxical problems with source lines are initially encountered, it might be thought that switching over to object lines or bytes of memory would avoid the situation. However, object code metrics have another problem that is almost as severe. Measurements based on object code tend to penalize optimizing compilers and to achieve their highest rates for the least compact efforts.

The paradox that true improvements are masked when expressed in terms of lines of code also affects quality, if all defect types are includ-



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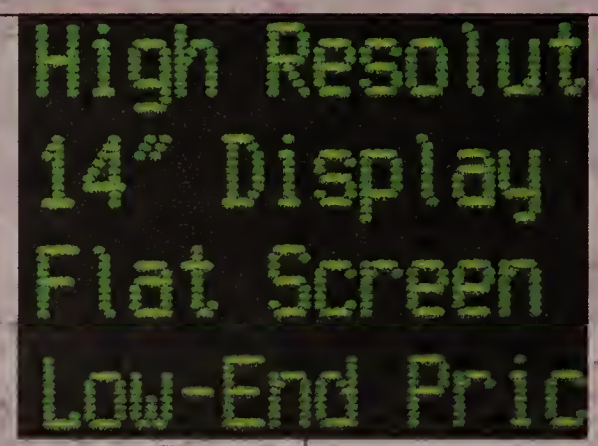

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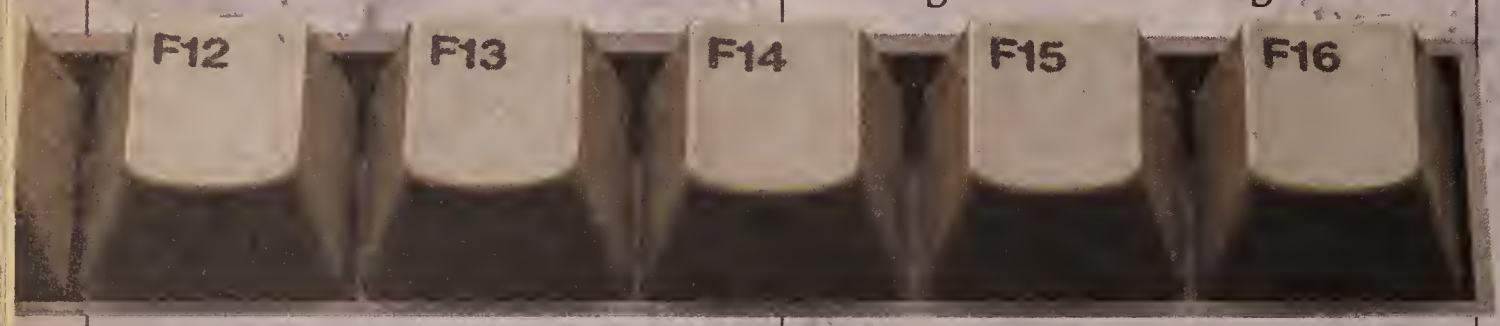

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ed. Figure 2 gives examples of the kinds of defect counts that might be anticipated in the assembler language, PL/I and APL examples shown in Figure 1.

Note that in spite of a significant reduction in total defects and an eightfold decrease in coding defects, the defect count normalized to defects per 1,000 lines of code heavily penalizes high-level languages. The reason is that for most large programming systems, errors outside the code are more significant than errors within the code.

The impact of the paradox has caused three major problems for the programming community. These have been critical in commercial and governmental programming, where costs, schedules and quality are often determined by contractual and marketing considerations.

First, the paradox has been a major factor in estimating errors, since many managers assume that switching from a given language to a higher level language will cause an increase in lines of code produced per time unit, when in fact it causes a decrease. Estimates made without consideration for the paradox are immediately off the scale, and projects will be more costly than anticipated.

Second, when productivity or quality comparisons are made between projects written in different languages, the paradox always penalizes the higher level language and conceals significant true gains in productivity.

Third, when measurements are made at the enterprise level, such as corporate productivity and quality metrics programs, the paradox sometimes causes management to think that productivity or quality has declined, when in fact migration from lower level to higher level languages has brought about an increase in economic productivity and in actual quality.

Once the mathematical paradox associated with trying to use lines of source code as a productivity indicator is understood, then we can compensate for it. Although using lines-of-code metrics is now possible without excessive distortion, the paradoxical results from incorrect and uncompensated historical usage have damaged the credibility of this metric to the point where it is unlikely that it will ever be fully credible again.

Cost per defect

One of the most widely repeated aphorisms of the software community is, "It costs up to 100 times as much to fix a bug during maintenance as it does during development." This statement, as it is commonly used, is incorrect and has no basis in fact. Here, too, a fundamental rule of industrial production has not been recognized. Cost per defect is always lowest where the number of defects found is greatest and always highest where the number of defects found is least.

Since the number of bugs found during development is usually much greater than the number of bugs found during production, the cost per defect will always be higher during production.

Indeed, for the few zero-defect programs being created, which still have some maintenance effort associated with them, cost per defect can reach infinity. This is because of the fixed and inelastic costs associated with defect removal (Figure 3).

The primary error introduced by cost per defect is failure to recognize that even high-quality, zero-defect software will have substantial costs associated with preparation and execution of defect removal activities, even though repair costs may be zero.

> ***"Once the mathematical paradox associated with trying to use lines of source code as a productivity indicator is understood, we can compensate for it."***

What occurs is that the fixed costs associated with preparation, training and readiness become increasingly significant as the variable costs decline, and this artifically drives up the cost per defect and leads to erroneous conclusions.

The major paradox associated with cost per defect is that as program quality improves, cost per defect will rise steadily until it reaches infinity for a zero-defect program; hence, this metric penalizes quality and rewards errors.

The cost-per-defect paradox has a mathematical reason for existing and does not reflect the actual work of finding and repairing faults. This reason is the common method of calculating cost per defect by simply dividing the total defect removal expenses by the total number of defects removed. This method ignores the fixed and inelastic costs of preparation and execution, which will still be incurred even for zero-defect programs.

Incidentally, the cost-per-defect paradox also occurs in fields outside of programming, such as computer hardware repair, but its significance is less understood for software than for other activities.

There are three independent sources of expense in removing defects:

- Preparation expenses, such as writing test cases.
- Execution expenses, such as running test cases.
- Repair expenses, such as fixing bugs and recompiling.

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Of these three, only the third is directly related to the number of bugs present in a programming system.

Once the paradox of cost per defect is understood, time and motion studies reveal true variations in defect removal efforts as a function of quality. As program quality improves in real life, both the number of simple bugs and the number of severe bugs are reduced at a faster rate than the mid-range defects. Thus, the defects encountered in high-quality programs, on the average, actually do take more effort to repair than the defects encountered in low-quality programs.

In low-quality software, the enormous numbers of relatively simple bugs tend to mask the more serious bugs when cost per defect is used to assess productivity. To understand the economics of defect removal, it is necessary to analyze preparation time, execution time and defect repair times separately. However, only a few reports have dealt with the fine structures of defect removal.

The fine structure of defect removal has been masked by the use of cost per defect, and it includes fixed costs such as preparation, inelastic costs such as execution and variable costs such as repairs.

Paradox of percentages

One of the most common methods in the programming industry for expressing the relative costs of programming activities is the use of percentages or ratios, such as the historical rule of thumb for assembler language programs that design will take 20% of a software development cycle, coding will take 30%, and integration and testing will take 50%; or the modern rule of thumb for high-level language programs that design will take 40%, coding will take 35%, and integration and testing will take 25%; or the hypermodern rule of thumb for spreadsheet programs that design will take 5%, coding will take 90%, and validation will take 5%.

Unfortunately, ratios and percentages have paradoxical aspects that cause them to be very inaccurate and unreliable. The ratio-and-percentage paradox is a subset of the line-of-code paradox; the first problem with using percentages is that they break down completely when programs in different languages are being compared.

There are many other phenomena that can cause ratios and percentages to vary widely from one program to another, and the general conclusion is that percentages invariably are misleading. Some of the other factors that cause ratio or percentage changes in otherwise similar programs are the following:

- Programs involving multiple development locations will have significantly different ratios from single-site programs.
- Programs involving new tools or insufficient tools will have significantly different ratios from programs developed with a well-formed tool set.
- Programs that are novel or of a kind with which the staff has no experience will have significantly different ratios from programs that are of a familiar type.

To demonstrate some of the cautions that surround ratios and percentages, it should be noted that coding, the heart of the software discipline, may vary from a high of 95% of all development effort for small personal spreadsheet programs to a low of less than 25% of all development effort for large government contract programs with significant documentation requirements, independent verification and validation and other ancillary tasks.

Percentages and ratios are hazardous and unreliable, and their common usage for software projects is one of the reasons for estimating and planning errors.

Defining lines of code

The next measurement problem to be discussed is not paradoxical, in that the results do not move backward or in counterintuitive directions as progress is made. However, the range of variation from inconsistent definitions of lines of code can yield apparent differences in both productivity and quality of more than 5:1.

Although the phrase "lines of code" is used daily by almost all commercial, industrial and governmental programming enterprises, there is no universally agreed-to definition for exactly what a line of code really is. There are 11 major variations in two sets that must be considered, plus the special case of how to count deleted code:

Set 1. Line-counting variations at the program level.

Method 1: Count only executable lines.

Method 2: Count executable lines plus data definitions.

Method 3: Count executable lines, data definitions and comments.

Method 4: Count executable lines, data definitions, comments and JCL.

Method 5: Count lines as physical lines on an input screen.

Method 6: Count lines as terminated by logical delimiters.

Set 2: Line-counting variations at the project level.

Method 1: Count only new lines.

Method 2: Count new lines and changed lines.

Method 3: Count new lines, changed lines and reused lines.

Defects as a quality indicator

	Assembler	PL/I	APL
Source lines	100,000	25,000	10,000
Defects source:			
• Requirements	500	500	500
• Design	1,500	1,500	1,500
• Coding	4,000	1,000	500
• Documentation	1,000	1,000	1,000
Total defects	7,000	4,000	3,500
Defects per 1,000 lines of code	**70**	**160**	**350**

Figure 2

Cost per defect within a software development cycle

	Number of defects	Fixed costs	Variable costs	Total costs	Cost per defect
Reviews	200	$5,000	$20,000	$25,000	$125
Testing	40	5,000	10,000	15,000	$375
Production	10	5,000	5,000	10,000	$1,000
Total	**250**	**$15,000**	**$35,000**	**$50,000**	**$200**

Figure 3

Method 4: Count all delivered lines plus temporary scaffold code.

Method 5: Count all delivered lines, temporary code and support code.

There is a range of as much as 5:1 between the most diffuse counting technique and the most compact. Since few authors bother to define the line-counting rules they used, much of the software productivity literature has an uncertainty of perhaps 500% attributable to line-counting variations — plainly an unsatisfactory condition.

As an example, a single Basic program analyzed by the author consisted, in round numbers, of 900 executable statements, 400 data definitions and 100 remarks or commentary statements. The average number of executable statements per physical line was 2.5. Counted in the most compact way, the program might appear to consist of 360 physical, executable lines. Counted in the most diffuse way, it might appear to consist of 1,500 total statements.

In his book, *Software Engineering Economics*, (Prentice-Hall, Inc., Englewood Cliffs, N.J., 1981) B. W. Boehm uses Method 5, while the data in this article uses Method 6.

The distinction between Boehm's method of counting code and the methods of other authors illustrates the generally hazy status of software measurements today. There are no current standards, and each researcher selects the technique that seems most appropriate. Since Boehm's book uses different methods from the ones used in this article, each would show the same programs as having different sizes.

For programs written in assembler language and restricted to a single physical line per statement, Boehm's

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method, which includes comments, should yield sizes about 15% larger than the method used here. However, for programs in Basic or other languages featuring multistatement lines, Boehm's method of counting physical lines rather than logical lines would yield sizes that are smaller by as much as 75%. Needless to say, when productivity researchers can define the size of the same program in ways that differ by several hundred percent, there is clearly a need for future standardization.

In the early days of programming, almost all programs were new, and all of the code was uniquely developed for each application. In this environment, it was appropriate to consider only new code production rates. But as the industry matures, more and more programming is done to add functions to existing systems. This is starting to trigger a subtle but profound change in both measurement and philosophy. What is important to productivity is not how fast a program can be developed but how fast the program functions can be delivered.

If measurement switches from development to delivery and reused code is considered in the productivity measurements, enormous productivity rates can be encountered. Depending upon the quantity of reused code, productivity rates of more than 25,000 lines of code per person-year are not uncommon, with peaks of more than 100,000 lines of code per person-year happening occasionally. Indeed, it is now technically possible to develop some new applications that consist entirely of reused code, with no unique hand-coded modules being developed at all.

The other line-counting variations listed previously in Set 2 are also concerns in industrial and commercial programming organizations. During programming development, a large amount of temporary or scaffold code frequently will be developed for testing purposes and then discarded when the program is complete. A question then arises: Should this temporary code be considered for productivity purposes? Most enterprises do not include temporary code in their productivity metrics, although a few projects may count temporary code separately for calibration purposes.

It may be necessary to develop tools and support packages before a new program can be completed. Should these tools be viewed as independent programs and measured separately, or should their development be considered as part of the effort for the program they support?

From a technical point of view, the tool and support programs would be better dealt with as independent programs and measured separately. However, it may sometimes happen that for contractual purposes, the expense of tool development will be added to the expense of developing the primary application covered by the contract.

Deleted code is technically the most difficult aspect of programming to measure. It is not uncommon for real-time programming systems to have considerable efforts devoted to pruning, or carefully going over the code to improve speed or reduce memory utilization. Obviously, any metric that equates productivity gains with developing more lines of code per time unit will come to grief when the activity being measured is the deletion of lines of code.

Perhaps the most common way of dealing with this situation is simply to ignore the deleted code. This, of course, drives down the productivity rate, but since performance tuning and code compression are difficult tasks, that reduction should be expected and planned for.

Combination techniques

The lack of standard line-counting methods for programming makes productivity and quality research difficult, but it does not make them impossible. However, one factor comes close to making the research impossible, or at least the results unusable, and that is to publish a study on programming productivity or quality without stating the line-counting method used.

This is a relatively common occurrence, unfortunately, and it means that much of the literature on software engineering productivity cannot be used for serious research because the definitions either are not included or are not sufficient

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to understand what was being measured. Since the possible variations span a range of greater than 5:1, there is no way that the omissions can simply be ignored.

Scope of effort

Once the fundamental paradoxes and uncertainties of dealing with lines of code have been overcome, a new and equally significant problem appears in the area of what human activities should be included in productivity measurements.

The widespread failure in the software literature to report exactly which activities were included in measurements and over what time period the measurements were taken has introduced potential uncertainties that in extreme cases can span more than two orders of magnitude.

The variation in apparent productivity is symptomatic of the fact that the software engineering literature has blurred together, without considering their various implications, three different concepts of productivity:

- Personal productivity.
- Project productivity.
- Enterprise productivity.

The first and oldest productivity concept is that of the personal productivity of an individual programmer. This concept was started by programmers themselves in the days when programming was done partly in machine language and partly in assembler language, and writing lines of code rapidly was such a difficult feat that those who could do it felt a justifiable pride in their accomplishment. Although historically the oldest, personal productivity is not a very satisfactory measurement method.

In the second productivity concept, project productivity, the concern is not just coding but the entire development cycle, ranging from requirements through delivery and sometimes out through maintenance. Although project productivity is still commonly measured in terms of lines of code, much of the work is no longer coding, and activities such as documentation, quality assurance and management must be considered.

The third, and emerging, productivity concept is that of productivity at the enterprise level, or economic productivity. Since economic productivity deals with goods and services produced per unit of labor and expense, productivity at the enterprise level deals with factors such as the cost of canceled projects, maintenance, capital equipment purchases, travel expenses, hiring and training expenses, real estate and many other functions that were not historically considered aspects of programming productivity, since they spanned many projects and were not "owned" by any single programming group.

Yet enterprise productivity is in many ways the most important topic of the productivity domain. Improving productivity at the enterprise level implies knowledge of cost elements such as hiring, relocation, project transfers, canceled projects and many others. A much broader scope of measurement and analysis is required to deal with enterprise productivity than to deal with personal and project productivity.

Peripheral activities

The desirability of considering economic and enterprise productivity brings up the point that modern programming spans a much broader range of activities than coding alone. Indeed, for a very large system such as an operating system or a military system, only about a fourth of the personnel involved may do any coding at all.

The following are discussions of the major peripheral and support activities that should be measured at the project and enterprise level.

Documentation. While smaller programming projects may have comparatively little documentation, the documentation requirements for large programming systems sometimes elevate documentation costs to the greatest single expense element. For example, an analysis of the documentation of a large telecommunications system revealed a total of more than 100 different kinds of documents produced and more than 60,000 total pages, with an overall total in excess of 30 million words. This was an average of 120 English words per line of source code.

While this was a fairly large system, the documenta-

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thoroughly tested, and much more accurate, which is very important to me."

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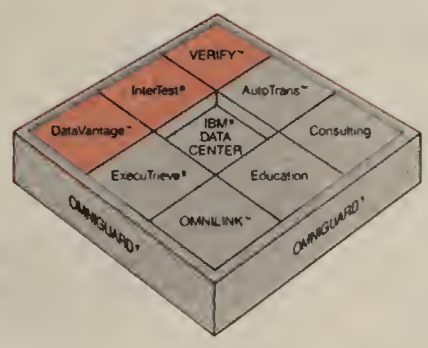

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tion produced was actually not unusually verbose. Large government and military systems may sometimes create more than 125 kinds of documents, more than 250,000 total pages and more than 125 million English words and may average more than 200 English words for every line in the delivered system.

Yet in spite of the very high costs associated with paperwork and software documentation, very few enterprises have measured this activity at all.

Defect removal. For medium-size to large programming systems, defect removal costs are usually the most expensive single activity, when all forms of defect removal — from desk checking through reviews and testing — are totaled. Yet, very few enterprises measure this cost, and a 1985 survey by Applied Computer Research, Inc. found fewer than 14% of the respondents measured software quality or defect removal.

In a large programming system of a relatively normal kind developed by designers and programmers of average skills, perhaps 30% of the total development effort is spent on defect removal activities: desk checking, reviews, inspections, tests and, of course, repairing the bugs that are discovered. With so much effort and cost involved, defect removal should be a high-priority measurement item.

> ***For medium-size to large programming systems, defect removal costs are usually the most expensive single activity.***

Travel and communications. The great majority of programming systems developed in the world are produced at only a single development location and have virtually no travel or communications costs. However, for programming systems that are developed among multiple locations and especially for those developed among international locations, travel and communications will be one of the top three expense elements and may sometimes be the most expensive.

One major software system, whose development involved five European locations and one U.S. location, required more than 3,000 trips, and the cost of travel and hotels actually exceeded the cost of coding.

Hiring and relocation. Because the turnover and voluntary attrition rate among programmers is in the vicinity of 12% in the U.S., most programming organizations have relatively high recruiting and relocation costs. By the time agency fees, furniture moves, mortgage assistance and other costs, as well as the expense of training new hires in company policies and methods, are totaled, from $25,000 to $75,000 per professional can be expended.

Capital equipment. It is interesting to note that the organizations at the leading edge in terms of productivity often average more than one terminal per programmer, accompanied by ample computing power and subsecond response time. One of the major issues in programming is to quantify just exactly what impacts capital expenditures have on programming productivity. Yet, this factor is seldom measured or quantified at the project level, and many companies do not even have a convenient way of linking capital purchases to individual projects.

Quality assurance. Within large corporations that have formal quality assurance organizations, the resources devoted to this activity range from less than 1% to the high of approximately 10% that IBM applies to marketed commercial systems. Quality assurance has developed some very interesting measurement techniques long used for hardware. Yet very few software projects make use of concepts such as "cost of quality" or the other quality assurance metrics of significance.

Training and education. It is not widely recognized, but the number of staff instructors and educational personnel in the set of Fortune 500 companies in the U.S. approximates the total faculty size of all U.S. universities. In terms of student-days, it is possible that the private, in-house training programs of major corporations approach the combined computer science departments of U.S. academic institutions.

For a number of corporations, technical training is a major commitment, and targets such as 10 to 20 days of training per staff member per year are not uncommon.

Although the evidence is not conclusive, in his book *Foundation for Growth — Productivity and Quality in Application Development* (Nolan, Norton and Co., Lexington, Mass. 1984), T. Lutz suggests a correlation between staff technical training and software productivity. Some correlation between staff education and productivity apparently may exist, since those organizations that encourage education and professional activities, such as IBM, Digital Equipment Corp. and AT&T Bell Laboratories, appear to be among the leading-edge organizations in terms of economic productivity.

Integration. While small application programs and microcomputer software may have no integration expenses at all, large systems may find 15% of the total development time and effort are associated with integration, or the tasks of getting the separate pieces of a large programming system to work together simultaneously.

Canceled projects. Very few enterprises include canceled projects in their productivity measures. Yet the overall impact of such projects can be very high. Within two large corporations, between 20% to 30% of all projects larger than 100,000 source statements were not completed and were canceled before delivery.

Measurement and tracking. Productivity and quality measurement is itself a significant cost element for those enterprises that do it. Within three large corporations, the number of full-time professional personnel engaged in measurement activities ranged from 1% to 3% of the total number of software professionals. When part-time and intermittent

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Meet our PC Modems

Choosing a modem for your personal computer just got easier.

Modems are remarkable little gadgets. They can connect you and your PC to mountains of data and oceans of information. But up until now, deciding which modem to buy hasn't been easy. So to solve that little problem, IBM is offering two 1,200 bps PC modems. Modems that not only give you the best features currently available on PC modems, but also offer features usually found only on higher priced, higher speed modems.

First, a Brief Introduction to the IBM PC Modems:

The IBM 5841 is a stand-alone modem capable of operating at 0-300, 600 and 1,200 bps in asynchronous mode, and 600 and 1,200 bps synchronous.

Our other modem is the IBM Personal Computer Modem—an internal, half-card modem that operates at 0-300, 600 and 1,200 bps asynchronous.

The Non-Identical Twins

In some respects, these two modems are very similar. For example, they both have Automatic Adaptive Equalization—which means they will continuously fine-tune themselves to compensate for changes and noises on the telephone line. The result is, you can receive data over a wider range of phone line conditions. This is one of those features more often found on faster, more expensive modems.

In addition to automatic answering, both modems offer Adaptive Dialing—which means that if you don't specify either tone or pulse dialing, the modems try tone dialing for one digit, and if that doesn't work, they automatically switch to pulse dialing.

Both modems will automatically redial a number as many times as you tell them to. Or if you prefer, they can switch to an alternate number on a busy signal or a no answer. Once a connection is made, the modems automatically detect and adjust to the incoming transmission speed. They can also initiate an automatic log-on sequence including control characters, ID number and password.

And both modems have extensive "Help" menus, a complete complement of built-in diagnostics, a programmable speaker, and two phone jacks on the back so both your phone and the modem can be connected to the same line at the same time. You can even switch between voice and data without interrupting the phone call.

A Modem with a Memory of Its Own

The IBM 5841 stand-alone modem has some additional features you don't usually find on 1,200 bps modems. For example, the modem is switchable between asynchronous and synchronous modes and has a 20-entry Dialing Directory. Kept in non-volatile storage, the directory enables the modem to dial up and log on to systems automatically. This feature is most convenient when the 5841 is used with a fixed-function ASCII terminal such as the IBM 3161 or 3163.

The front panel of the 5841 has a complete array of eight LED Status Indicators to give you a quick visual check on what's happening.

A Half-Card Is Better Than a Whole

Why? Because the IBM Personal Computer Modem can use a short slot in the IBM PC XT and the *Portable* PC. It also fits nicely into a full slot in the IBM PC and the PC AT.

Another nice touch is that a PC diagnostic diskette comes with each of these half-card modems.

Standards & Compatibility

You'll be pleased to know that both modems meet the Bell 103/212A and V. 22 CCITT standards. Both can use the industry standard "AT" command set, as well as the IBM command set. And both modems have been tested for compatibility with leading PC communications software such as the IBM PC Communications Manager, Crosstalk™ XVI, Smartcom II® and Transporter.™

So if you've been thinking about tying your PC into your company's computer, or accessing an outside data base for stock market information or airline schedules, or using electronic mail, or just exchanging information on a user group's bulletin board—then it's time you got an IBM modem for your PC.

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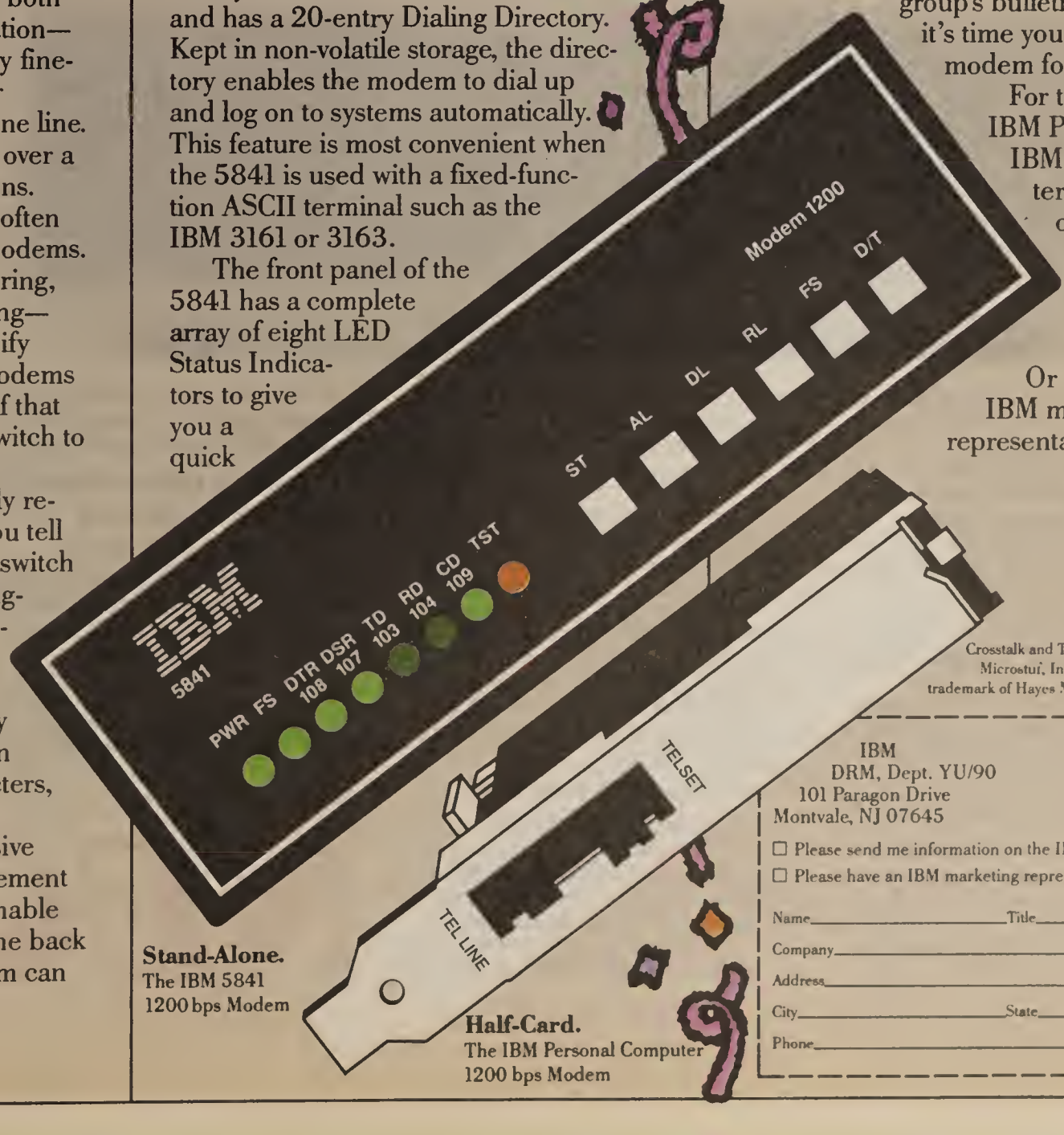

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workers, such as project managers or staff workers that supply data, were considered, productivity and quality measurements approached 7% of all development effort.

Noncoding activities

Since considerably less than half of the effort on large programming systems is devoted to coding, another question arises: What kinds of measurements exist for the noncoding activities?

Productivity has three different meanings that should be, but often are not, considered in the context of measurements:

- Productivity in the sense of speed.
- Productivity in the sense of cost.
- Productivity in the sense of yield.

When attempting to improve the productivity of a given activity, is it more important to speed up the activity or to lower its cost?

Since the metrics and technologies that relate to speed are not necessarily the same as the ones that relate to cost or to yield, this distinction can lead to very different conclusions.

This lack of measures for speed and yield has introduced subtle distortions into the overall understanding of software productivity. For example, the lack of full-life-cycle speed measures has caused undue emphasis on the few activities, such as coding, that do have common speed measures. The lack of common yield measures has slowed down the economic analysis of software.

Economic measures

The overwhelming historical emphasis on lines of code has been the central theme of most programming measurement studies. However, as programming becomes a mature discipline, other alternatives are being explored.

Economic productivity is defined as goods or services produced per unit of labor or expense. When programming is analyzed in terms of this definition, a significant problem arises: What, exactly, are the services that a program performs, or how can a program be viewed as "goods"?

Although software and programming lack absolute productivity measures that are effective and they lack economic productivity measures, it is possible to deal with productivity in a relative fashion.

For example, suppose that a small manufacturing company developed an order-entry system in 1975 with a new and inexperienced staff of personnel and no particular use of structured programming methods. At that time, the system took 12 calendar months and 150 person-months to develop.

In 1985, the company was ready to replace the system with a new version, but this time the personnel were experienced, and full use was made of the structured programming methods. The new system is functionally equivalent to the old but was completed in only six calendar months requiring only 50 person-months for development.

From this type of analysis, it may be seen that economic productivity improved significantly: Identical functions were produced in only half of the calendar time with only one-third of the resources. This kind of analysis does not yield absolute productivity measures, but it provides helpful information about significant trends and improvements.

Note that if the two projects were compared by means of hazardous metrics such as lines of code, the improvements would not be so visible. Indeed, if the company's early system were written in assembler language and took 30,000 source statements, and if its new system were written in Cobol and took only 10,000 source statements, they both would have identical productivity rates of 200 lines of code per person-month.

Only for costs are there relatively stable measures; this is one of the reasons the cost of software production is much better understood than either speed or yield.

As of this year, it can finally be said that the problems of software metrics have been explored and mapped, even if the problems have not yet been solved. From this point on, new metrics can be developed that are free of the distortions and paradoxes that have been so troublesome in the past. ■

(Part 2: How not to measure programming quality.)

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The DSP 19200M features an LED-enhanced, integrated soft touch Key Pad. It allows you to use a pattern generator, a bit error rate tester, and remote loopbacks in order to easily diagnose problems.

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NEW PRODUCTS

DEC units get subsystem

Model 41 provides noninterleaved disk data transfer

Scientific Micro Systems, Inc. has announced the SMS 1000 Model 41, a high-throughput data storage subsystem designed to operate with any Digital Equipment Corp. Microvax II or LSI-11 computer system.

The Model 41 combines up to 280M bytes of Winchester storage with floppy and tape drive options. It offers a range of configurations including 8-in. (1.2M byte) or 5¼-in. floppies, which are DEC RX50-compatible and double sided to provide twice the capacity of the standard RX50 drive.

Scientific Micro Systems' storage subsystem for DEC's Q-bus architecture.

Also available is a 60M-byte, 5¼-in. offline streaming cartridge tape and an online, file-oriented tape system said to allow the running of all DEC software, the vendor said.

Standard performance features of the Model 41 include noninterleavered disk data transfer, overlapped seeking, seek ordering, flaw mapping and error correction. High-performance 5¼-in. Winchesters provide a transfer rate of 625K bit/sec. and an average access time of 27 msec.

The Model 41 integrates the mass storage device controller, all backplane circuitry and the Sense Monitor on a single board. The Sense Monitor contains resident firmware and hardware used for system status analysis, system utilities and diagnostics. According to the vendor, the user interface may be customized according to the user's level of understanding and can be operated from the Model 41's front panel or from a menu-driven console terminal.

The SMS 1000 Model 41 is priced ranging from $18,000 to $6,000, in quantities of one to 50.

Scientific Micro Systems also announced the compatibility of its entire 1000 series with the Microvax II.

NCR micro-CPU link series out

Remote line allows for IBM terminal emulation

NCR Corp. of Dayton, Ohio, rolled out a line of communications products designed to let its personal computers link with corporate mainframes and emulate a number of IBM terminals.

The Remote series, made up of 10 products, is available in four basic packages: the IBM 3270 bisynchronous emulation, IBM 2780/3780 bisynchronous RJE emulation, IBM 3270 Systems Network Architecture (SNA) emulation and IBM 3770 SNA RJE emulation. Each is based on a synchronous adapter board, which fits into a long or short board expansion slot on an NCR personal computer and sells for $400.

There are four $890 packages — the DOS/Bisync 3270, the DOS/Bisync 2780/3780, the DOS/SNA Synchronous Data Link Control (SDLC) 3270 and the DOS/SNA SDLC 3770 — that require the adapter board. Also included in this series are software-only packages that sell for $595 each and allow users to migrate from one protocol to another.

NCR's coaxial series, made up of four products, is sold in two basic packages: IBM 3270 terminal emulation and IBM 3270 PC emulation. A coaxial adapter board, which sells for $1,195 and fits into any long card slot on an NCR personal computer, provides the link to IBM 3270 networks.

The DOS/Coax 3270 PC Emulator, which provides an NCR personal computer with a link to an IBM 3270 network and connects it to the IBM 3274 and 3276 controllers, as well as terminal controllers with Type A adapters, sells for $1,595. The DOS/Coax 3270 Emulator costs $1,195. A windows utility and file transfer utility cost $149 and $115, respectively.

Triangle's three Cobol utilities debut

Triangle Software Co. of San Jose, Calif., introduced the Perfix family of utilities designed to speed up and simplify Cobol program maintenance.

The three utilities — Illustrate, Crosscheck and Finaltest — are said to help automate the once manual procedures of Cobol program maintenance and testing while running under OS/VS and DOS.

The Illustrate utility displays a hierarchical structure chart showing program flow and execution. According to the vendor, it simplifies maintenance, training and documentation on structured Cobol programs by automatically generating hierarchical structure charts and related information.

Charting both the structure and logic of a program eliminates the need for searching through source code listings and reduces time and resources spent on training new programmers.

The Crosscheck program is a file comparison utility. It compares any two source programs, job control language or card-image data files and identifies the specific differences between them. Detailed reports show all additions and deletions.

The program features a file matching technique that allows the comparison of two files of any size and type. The program will pinpoint the location of changes made during program updates for easier debugging, verify that source code or files were not accidently added or deleted and automatically provide doumentation of program and file maintenance changes.

The Finaltest program reportedly reduces production failures caused by incomplete testing before turnover. The utility verifies that the program is thoroughly tested before turnover to production by automatically identifying all unexecuted paths and related branches. The program helps users to avoid production failures by improving program testing, to eliminate guesswork by clearly identifying untested program paths and to determine where to fine-tune test data until test coverage is complete.

Each product is priced at $1,650 per year for a three-year license or $375 rental per month.

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Graphics, text station bows

Forward Technology, Inc. of San Jose, Calif., has introduced the Graphtext I graphics and text station that combines a stand-alone graphics workstation with a high-resolution VDT.

The Graphtext I merges bit-map and raster scan technology with the ability to edit locally and support a full-page display. It offers a total of 16 pages of memory or graphics characters that can be downloaded, stored and edited at the station locally without accessing a host.

The Graphtext I was designed to operate with AT&T Unix and VMS systems. It is compatible with Digital Equipment Corp. VT100 and VT52 and Tektronix, Inc. 4010 and 4014 protocols. It can also serve as an intelligent extension port of the DEC Microvax II and stand-alone workstations.

The monochrome monitor of the Graphtext I has a 15-in. screen and offers 1,024- by 768-pixel resolution. Standard capabilities include multiwindowing, multifonts and use of a mouse.

Host interface operates through either a pair of RS-232C ports or a single RS-422 port. Interface with laser printers for local re-creation of documents is also possible.

The Graphtext I is priced at $2,950.

Tandon add-in card boasts Winnie, 21.3M-byte capacity

Tandon Corp. of Chatsworth, Calif., has introduced the Diskard 21, an add-in card that contains an integral Winchester disk drive.

The Diskard 21 has 21.3M bytes of formatted capacity.

The product reportedly plugs into a single slot in any IBM Personal Computer, Personal Computer XT or compatible.

No accessory boards needed

According to a spokesman, the Diskard 21 is easy to use. It does not require any accessory boards, cables or installation software.

Diskard 21 has plug-in compatibility with IBM PC-DOS and Microsoft Corp. MS-DOS 2 and higher. Media is plated, and power consumption is 11W.

A dedicated head parking zone off the data surface is provided for increased data protection, and the heads are positioned using a temperature-compensated, pseudo-closed-loop system.

Diskard 21 add-in card is priced at approximately $995, according to the vendor.

The Xerox Voice Message Exchange.

There's more to choosing an effective voice message system than just buying the right equipment.

With the Xerox Voice Message Exchange, installation isn't over when the hardware's plugged in. You see, there's a system behind our system.

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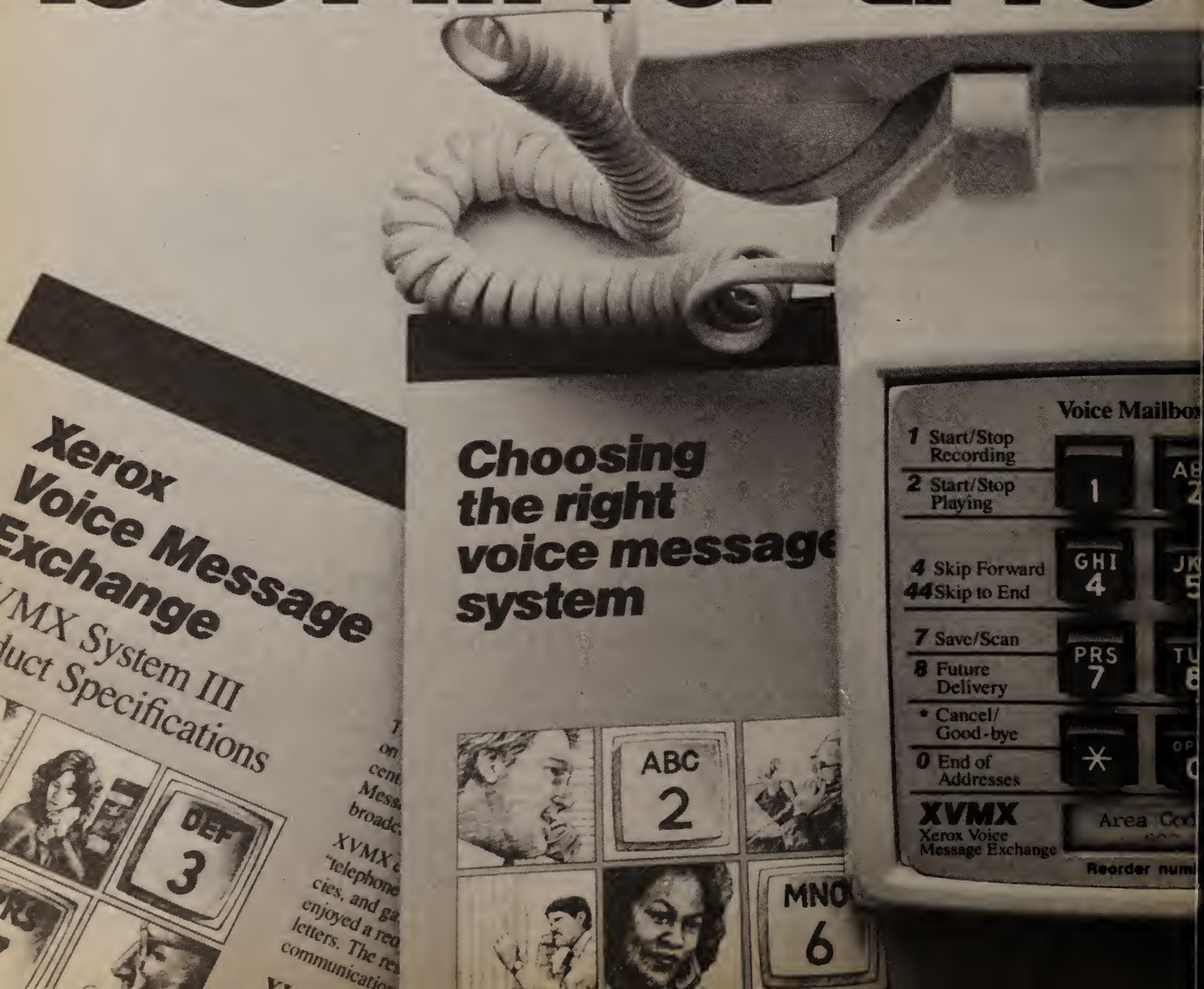

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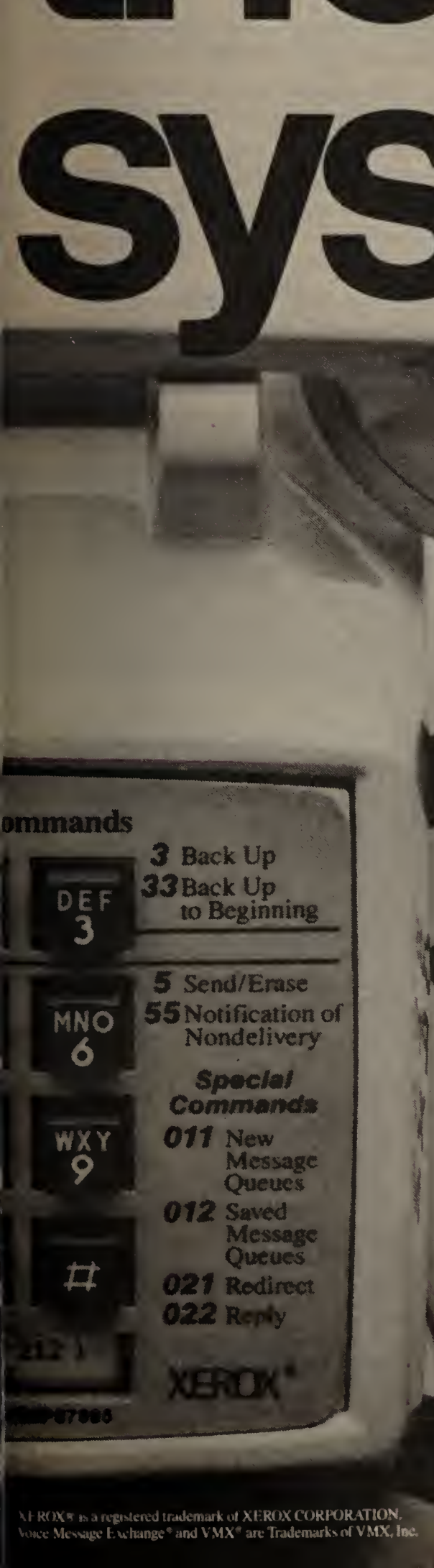

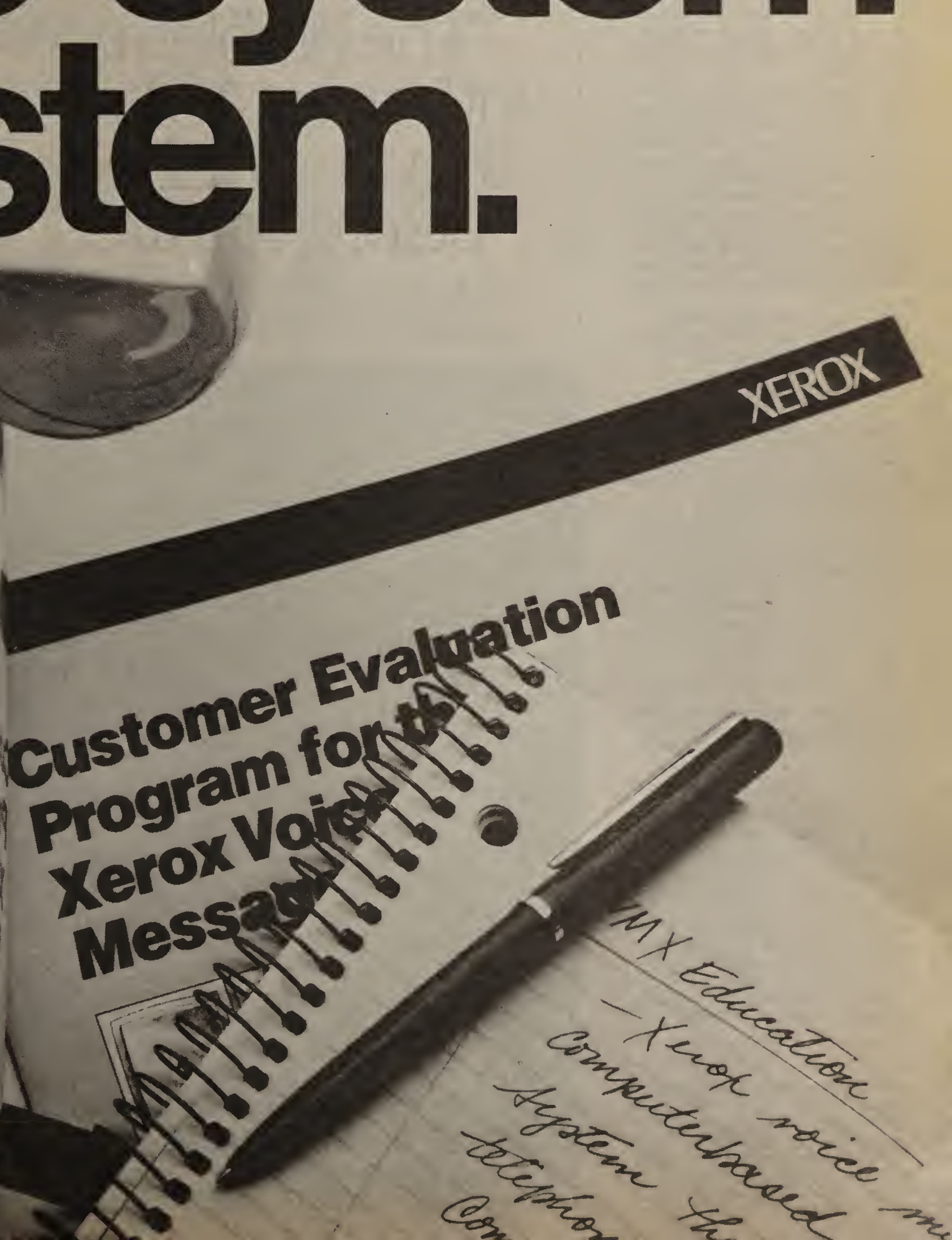

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SOFTWARE & SERVICES

Systems software

Hewlett-Packard Co. has upgraded its **HP 50955A** IBM 3278 display station emulator to run on the HP 9000 Series 200 and 300 engineering workstations with the Pascal 3.1 operating system.

The Pascal 3.1-based version provides bidirectional file transfer capability for IBM VM/CMS and MVS/TSO operating systems and for emulation of an IBM 3278 display station.

The emulator operates with bit-mapped and alpha/graphics displays, HP-HIL and HP 9816/9836 keyboards and printers and mass-storage devices are supported by Pascal 3.1. The HP 50955A costs $1,500.

HP, 3000 Hanover St., Palo Alto, Calif. 94304.

■

Klein Allen Co. has announced **External Program Calls** for the IBM System/36.

External Program Calls allows an RPG program to load and execute other RPG programs. It provides a communications path that permits programs to dynamically pass data and indicators back and forth.

The program eliminates redundant code and reduces overlapping program functions. With the product, conventional System/36 limits on program region size, number of allocated files and number of arrays can be bypassed.

The product licenses for $450.

Klein Allen, #3 20 South Center, American Fork, Utah 84003.

■

Panasophic Systems, Inc. has announced **Panaudit Plus 2**, an enhanced version of its auditing system for testing and reporting on data stored in computer files.

Recent features include enhanced routines such as encrypt/decrypt, data base access and expanded processing capabilities.

It costs $19,900 for OS versions and $15,900 for DOS versions.

Panasophic, 709 Enterprise Drive, Oak Brook, Ill. 60521.

■

New Unit, Inc. has announced **Plot**, a data analysis program for scientific users featuring publication-quality graphic output.

Plot is available for Digital Equipment Corp. PDP-11 and LSI-11 systems running TSX-Plus and all VAX systems running VMS. Features include command file nesting to 15 levels, user-definable functions, variables and up to 32,0000 data points.

Plot requires no coding. It has five resident character sets and offers support for up to 50 output devices.

Plot is priced at $1,000 for TSX-Plus and $2,500 for VMS versions.

New Unit, DeWitt Building, 215 N. Cayuga St., Ithaca, N.Y. 14850.

■

General Electric Co. has unveiled **GE-CAPP-Plus,** a computer-aided process planning package said to increase factory production rates, shorten planning cycles and reduce overall manufacturing costs.

The base system creates, stores and retrieves plans. Other modules use word processing techniques to create and modify plans, classify and code parts to form parts families and modify existing plans and storage.

A Graphics/GE-CAPP-Plus Interface module allows the system to accept graphic input from external sources and display them at workstations.

Other modules display plans on shop floor terminals, calculate operation and planning times from lot sizes, set up times to develop time standards or analyze group technology for optimum machine utilization.

Available for Digital Equipment Corp. VAX units, GE-CAPP-Plus can be licensed for between $50,000 and $125,000, depending on system size.

GE, Industrial Automation Systems Department, 12 Corporate Woods Blvd., Albany, N.Y. 12211.

Application packages

Versatec has introduced **Release 2** of its **Versaplot Random** plotting software for IBM OS/MVS, VS and VM/CMS computers.

Release 2 supports eight line colors, 256 predefined area colors, 256 user-definable area colors, as well as monochrome plotting.

Call compatible with pen plotter programs, the software lets users define clipping windows, plotting viewports and pen attributes such as width and color. Both hatched and solid colors can be generated.

Plotter widths run 24, 36 and 42 in. by virtually any length.

Release 2 is available on nine-track, 1,600 bit/in. magnetic tape for $6,000.

Versatec, 2710 Walsh Ave., Santa Clara, Calif. 95051.

M. Bryce & Associates, Inc. has announced **Version 7.2.1** of its **PMC2** project management system.

Enhancements include a revised project scheduling subsystem used to plot project schedules automatically while coordinating resource allocations.

The project scheduling subsystem can be used to coordinate multiple projects and multiple resources simultaneously. The scheduler also works in conjunction with a computer-aided estimating subsystem included in the product.

PMC2 runs on IBM MVS, Honeywell, Inc. GCOS and Digital Equipment Corp. VAX/VMS, the vendor said.

The price ranges from $35,000 to $45,000.

M. Bryce & Associates, 777 Alderman Road, Palm Harbor, Fla. 33563.

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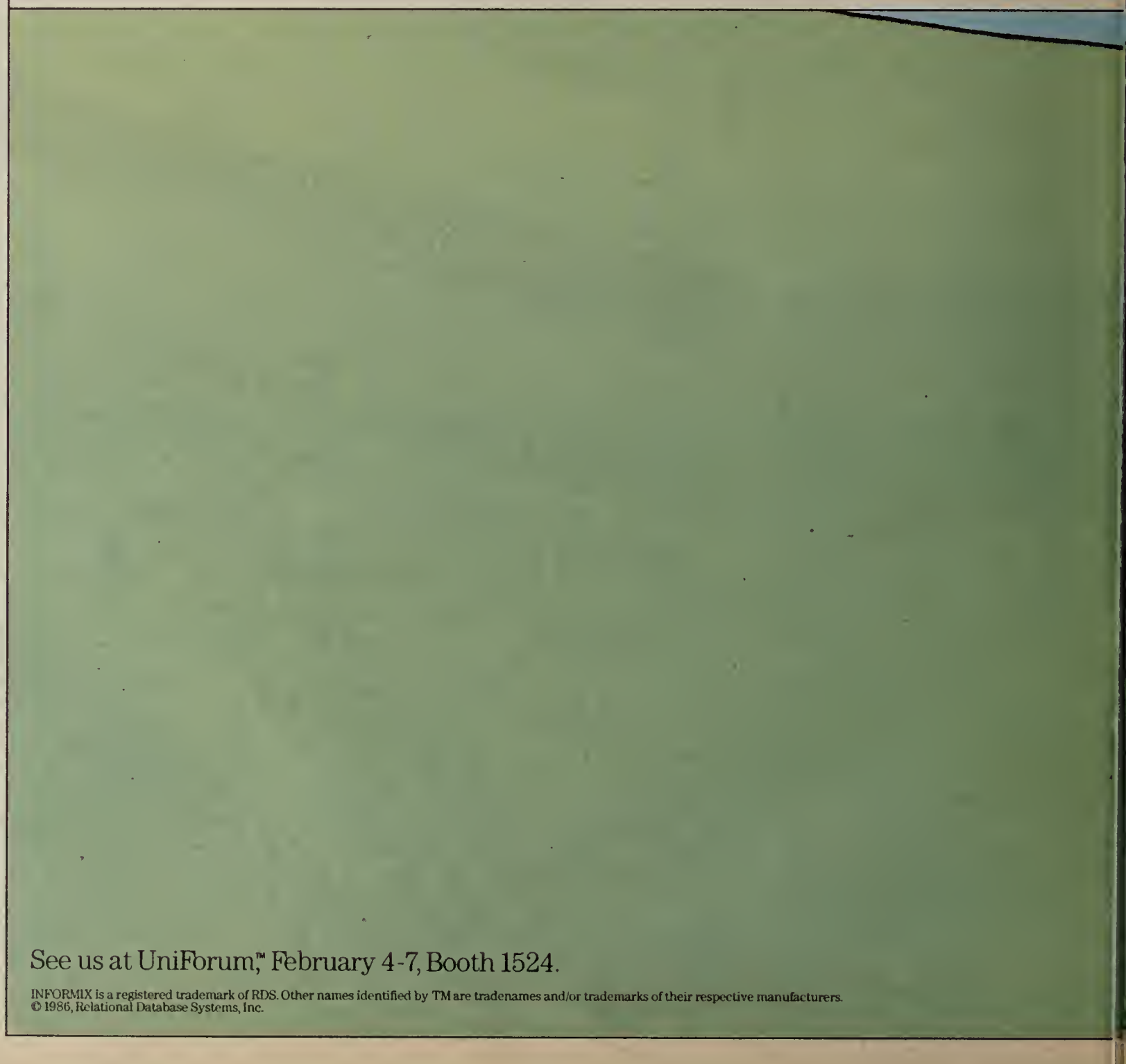

See us at UniForum,™ February 4-7, Booth 1524.

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NEW PRODUCTS/SOFTWARE & SERVICES

Modtech Loan Processing System (LPS), software for quantifying and verifying personal and financial data when tracking home loan applications, is available from **Modern Technologies International, Inc.**

The package manages loan application data from the time forms are first generated for each applicant.

Designed to support single-user DOS and multiuser AT&T Unix-based systems, LPS provides a series of unstructured data fields into which users enter applicant information. It also offers a multilevel security system that reportedly prevents unauthorized access to information.

Pricing starts at $2,995 for DOS versions and $5,995 for Unix systems.

Modern Technologies International, Suite 302, 656 Bair Island Road, Redwood City, Calif. 94063.

Methodologies

Tamp Computer Systems, Inc. has announced the **Disaster Recovery System**.

The Disaster Recovery System contains a comprehensive plan that can be adapted to any environment. It is based on Tamp's six-phase approach methodology. The Disaster Recovery System includes sample questionnaires, interoffice memos, external letters and the instructional information necessary to complete a disaster recovery project.

The system is available on floppy disk ready to be implemented under IBM Personal Computer-compatible word processing applications and in hardcopy format.

The price is $9,500.

Tamp Computer Systems, 1732 Remson Ave., Merrick, N.Y. 11566.

Training

McGraw-Hill Training Systems has added a Reflex data base software tutorial called **Faststart Reflex** to its Faststart training series.

Faststart Reflex runs simultaneously with the applications software, allowing the user to perform tasks such as creating and storing files. The tutorial is compatible with Reflex from Analytica Corp. and Reflex: The Analyst from Borland International/Analytica.

Priced at $69.95, Faststart Reflex requires an IBM Personal Computer with at least 384K bytes of memory and two double-sided disk drives or an IBM Personal Computer XT and one double-sided disk drive.

McGraw-Hill Training Systems, 4th Floor, 1221 Avenue of the Americas, New York, N.Y. 10020.

Henco Software, Inc. has announced **Info Computer-Based Training** (Info CBT), a course on Henco's Info data management system.

The course comes on 5¼-in. and 3½-in. diskettes and is designed to run on IBM Personal Computers and compatibles as well as Data General Corp. DG/One and Dasher/One systems.

Info CBT includes a series of diskettes containing 22 interactive lessons, an Info Pocket Reference Guide and a course workbook. Lessons start with an introduction and continue through advanced concepts and facilities.

Info CBT costs $1,200.

Henco Software, 100 Fifth Ave., Waltham, Mass. 02154.

■

Advanced Systems, Inc. has announced **MVS System Operator Commands**, a computer-based training course designed to teach MVS computer operators how to use MVS/XA and MVS/SP system commands more effectively.

The course works interactively to teach the 39 MVS system commands, including XA. It covers basic command syntax and console procedures and takes users through more than 100 simulated operating situations.

The course contains 16 units on four microcomputer diskettes, a student guide and reference cards. It runs under the IBM PCIS or Trainer 3000 and may be uploaded to run under the Mainframe IIS system.

The course costs $6,000.

Advanced Systems, 155 E. Algonquin Road, Arlington Heights, Ill. 60005.

■

Miller Smith, Inc. has announced **training seminars** on IBM System/38 data base design.

The two-day seminars will take place in the Denver area. They are said to provide a study and review of IBM System/38 data base design, analysis and installation. Topics covered include business modeling techniques, building the data structure diagram and constructing a logical data base design example.

Seminar fees, including workbooks, are $295 per student. Seminars for 1986 are scheduled for Jan. 23 and 24, Feb. 20 and 21 and March 20 and 21.

Miller Smith, P.O. Box 33517, Denver, Colo. 80233.

■

Relational Data Base Services, Inc. has announced five new **seminars** in its winter and spring 1986 seminar offerings.

The new seminars include a three-day System Manager's Workshop and one-day seminars including Designing and Relocating Computer Centers; System 1032 Efficiency; Data Base System Design Techniques; and Host Language Programming with System 1032.

Seminars are scheduled in North Carolina, New York, Florida, Texas and Illinois throughout the year. One-day seminars are priced at $360 per student, and three-day seminars are $940 per student.

Relational Data Base Services, P.O. Box 644, 121 S. Main St., Kernersville, N.C. 27285.

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INFOTRON SYSTEMS

MICROCOMPUTERS

Software

Impell Corp. has announced that its **Caemis** integrated system of computer-aided design, engineering and manufacturing software is now available for Digital Equipment Corp.'s Microvax II computer.

Caemis software enables engineers to produce three-dimensional structural, piping and mechanical part designs, execute engineering analysis and create annotated engineering drawings.

The Microvax II can accommodate any combination of Caemis applications modules.

Caemis pricing starts at $15,000.

Impell, Technology Park, 333 Research Court, Atlanta, Ga. 30092.

Ellis Computing, Inc. has announced a compiler called **Utah Fortran** for IBM Personal Computers and compatibles.

The compiler is based upon ANSI 66 standards. Features include chaining with named and blank common, IF-THEN-ELSE contructs, 150 verbal error messages and random-access file support.

The compiler requires one disk drive, 128K bytes of random-access memory and IBM PC-DOS 2 or higher.

Utah Fortran costs $39.95.

Ellis Computing, 3917 Noriega St., San Francisco, Calif. 94122.

■

Programmed Intelligence Corp. has announced **Integrated Query**, software that combines a reasoning-based query system, custom report writer and graphics package for interfacing to any type of data base.

The tool merges information from an unlimited number of files, sorts, totals and subtotals automatically.

The product automatically interfaces to Lotus Development Corp. 1-2-3 and Ashton-Tate Dbase II and III.

The system costs $150 for Dbase or Lotus 1-2-3, $250 for both Dbase and Lotus 1-2-3 and $500 for a universal file interface.

Programmed Intelligence, Suite 5, 3069 Amwiler Road, Atlanta, Ga. 30360.

■

Desktop A.I. has introduced the **DBX Translator** system, designed to enable users to move Ashton-Tate Dbase programs into the C language.

The system includes a language translator for processing Dbase source and a runtime library tool box to replace the Dbase screen handler. The system is available under Microsoft Corp. MS-DOS and Xenix and AT&T Unix. The package price ranges from $350 to $1,000.

Desktop A.I., #3, 1720 Post Road E., Westport, Conn. 06880.

■

Structured Software Systems, Inc. has upgraded its **HPL-Plus** operating system to run on Hewlett-Packard Co. Series 300 desktops.

HPL-Plus supports color graphics, is compatible with programs written to run on HPL Version 2.1 and is compatible with the original HPL.

HPL-Plus is priced at $600.

Structured Software Systems, Box 1072, Irick Road, Mount Holly, N.J. 08060.

■

International Computing, Inc. has announced **Unit Conversions**, a software program for IBM Personal Computers and the Apple Computer, Inc. Apple II family.

Unit Conversions allows users to reference 3,550 measurement conversions within two different families of units. It requires a minimum of 64K bytes of memory for the IBM Personal Computer, 128K bytes for the Personal Computer XT and AT and 48K bytes of memory for the Apple II family.

Unit Conversions costs $49.95.

International Computing, 1501 Monroe St., Madison, Wis. 53711.

■

Texas Instruments, Inc. has announced **Arborist Release 2** decision tree software that works with Lotus Development Corp.'s 1-2-3.

Arborist Release 2 is used for examining decisions and incorporating uncertain data into spreadsheet analysis. It has a window-based structure that allows users to view several interdependent concepts simultaneously. The new release has enhanced internal modeling capabilities. It is written in PC Scheme Lisp.

Arborist Release 2 costs $595.

TI, Data Systems Group, P.O. Box 2909, M/S 2180, H-827, Austin, Texas 78769.

■

Micro Data Systems, Inc. has released **Version 3.1** of its **Escrow Accounting System II**.

The new version provides multiuser capabilities. It maintains investment company codes, title policy numbers and legal descriptions. It processes interest-only, principle-only and standard escrows. It is compatible with Digital Research, Inc. CP/M, CP/M-86, MP/M II and MP/M-86 and Microsoft Corp. MS-DOS- or IBM PC-DOS-based micros.

Version 3.1 retails for $2,495.

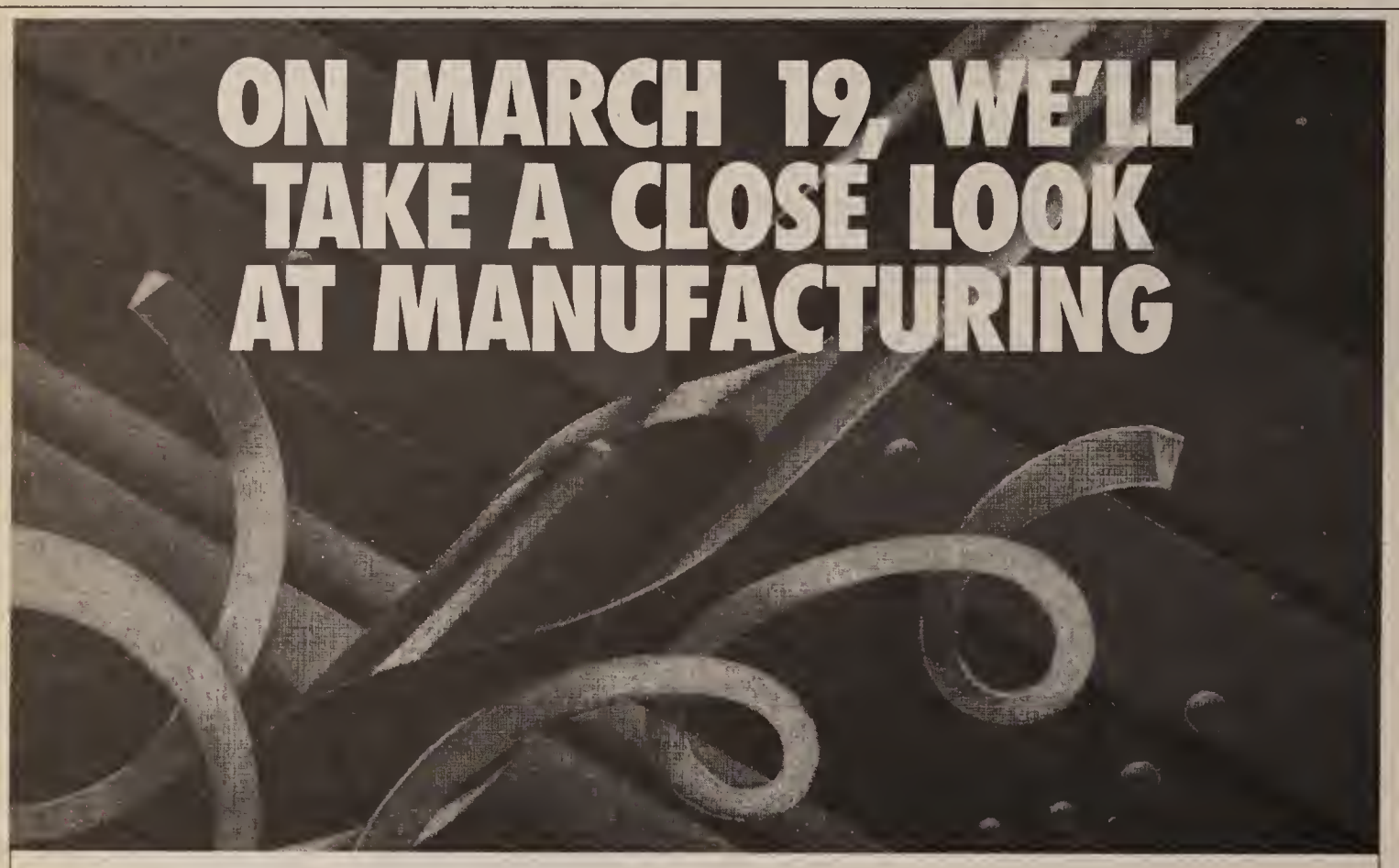
Micro Data Systems, 1314 N. Fourth St., Coeur D'Alene, Ind. 83814.

■

Lattice, Inc. has introduced the **Lattice Screen Editor**.

The Screen Editor offers a multiwindow feature that allows two files to be edited simultaneously and

Continued on page 85



Ultimately, computers will extend to every department in every company. And when they reach the factory floor, the MIS/DP department will be called in to help with the decisions.

That's why any vendor involved in computer-controlled manufacturing will want to be in the March issue of Computerworld Focus, where we'll tackle some of today's biggest issues in computer-aided manufacturing.

MIS/DP professionals will learn what they need to know to make intelligent decisions about integrating design and manufacturing systems within the corporate network. About factory networks, CAD/CAM, robotics and MRP. That way they can make sure the newest methods will integrate smoothly with existing and future systems. And productivity will be improved, not disrupted.

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March's Computerworld Focus will present a special section devoted to CAD/CAM. We'll find out what's available now — both products and development tools. Who the major vendors are and where they're taking us. And we'll take a good hard look at the task of implementing and maintaining a CAD/CAM system within an organization.

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For more information, contact Ed Marecki, Vice President/Sales, Computerworld Focus, 375 Cochituate Rd., Framingham, MA 01701, (617) 879-0700. Or call your local Computerworld sales representative.

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NEW PRODUCTS/MICROCOMPUTERS

Continued from page 84

provides cut-and-paste functions between files. Other features include block move, keyboard macros, variable tab settings, insert or overwrite text entry, an error tracking mode, three assembly language input modes and pattern searches.

The Lattice Screen Editor runs under Version 2 or higher of Microsoft Corp. MS-DOS or IBM PC-DOS. It requires 128K bytes of memory and is priced at $125.

Lattice, P.O. Box 3072, Glen Ellyn, Ill. 60138.

Communications

ARC Data Systems, Inc. has announced the **PC.25**, an integrated software and hardware X.25 communications package for the IBM Personal Computer, Personal Computer XT, AT, 3270 Personal Computer and compatibles.

The PC.25 includes software, hardware and a user library. It operates under Microsoft Corp. MS-DOS and AT&T Unix. It supports up to 32 simultaneous communications sessions.

The PC.25 package is priced at $1,350. Optional asynchronous/synchronous modems cost $795 for 2,400 bit/sec. and $1,495 for 9.6K bit/sec. A systems integrator kit including three PC.25s, a technical reference manual and source code for the PC.25 user interface costs $5,000.

ARC Data Systems, 1824-D Fourth St., Berkeley, Calif. 94710.

■

Emerald Technology Group, Inc., Software Systems, Inc. and **Universal Data Systems, Inc.** have announced the **PC/5251 Mate**, a communications device designed for communications between IBM Systems/34, 36 and 38 and remote IBM Personal Computers.

PC/5251 Mate integrates 5251 Model 12 terminal emulation, a synchronous modem and an autodialer on a single Personal Computer board. It is available in two configurations: the PC/5251 Mate-24, which includes a 2,400 bit/sec. modem, and the PC/5251 Mate-48, which includes a 4.8K.bit/sec. modem.

The list prices of PC/5251 Mate-24 and PC/5251 Mate-48 are $1,395 and $1,995, respectively.

Emerald Technology Group, Suite 102, 1602 116th Ave. N.E., Bellevue, Wash. 98004.

■

Pertec Computer Corp. has announced **PC-On-Coax**, an interface that allows IBM Personal Computers to be networked with the multitasking, multiuser Pertec System 3200 family of cable computers.

In addition to retaining all of the Personal Computer's stand-alone capabilities, PC-On-Coax adds two operating modes: a networked Personal Computer mode using the 3200 as a file and printer server and a terminal mode using the 3200 as a multiuser host computer.

PC-On-Coax is priced at approximately $695 for each connection.

Pertec Computer, 17112 Armstrong Ave., Irvine, Calif. 92713.

Digital Products, Inc. has introduced the **Sub-Lan**, a hardware-software combination network for personal computers.

Sub-Lan implements an asynchronous net. The hardware is the firm's Netcommander, an intelligent asynchronous data exchange. The software is Server Technology, Inc.'s Easylan and Communications Research Group, Inc.'s Blast communications packages as well as Digi-

Continued on page 86

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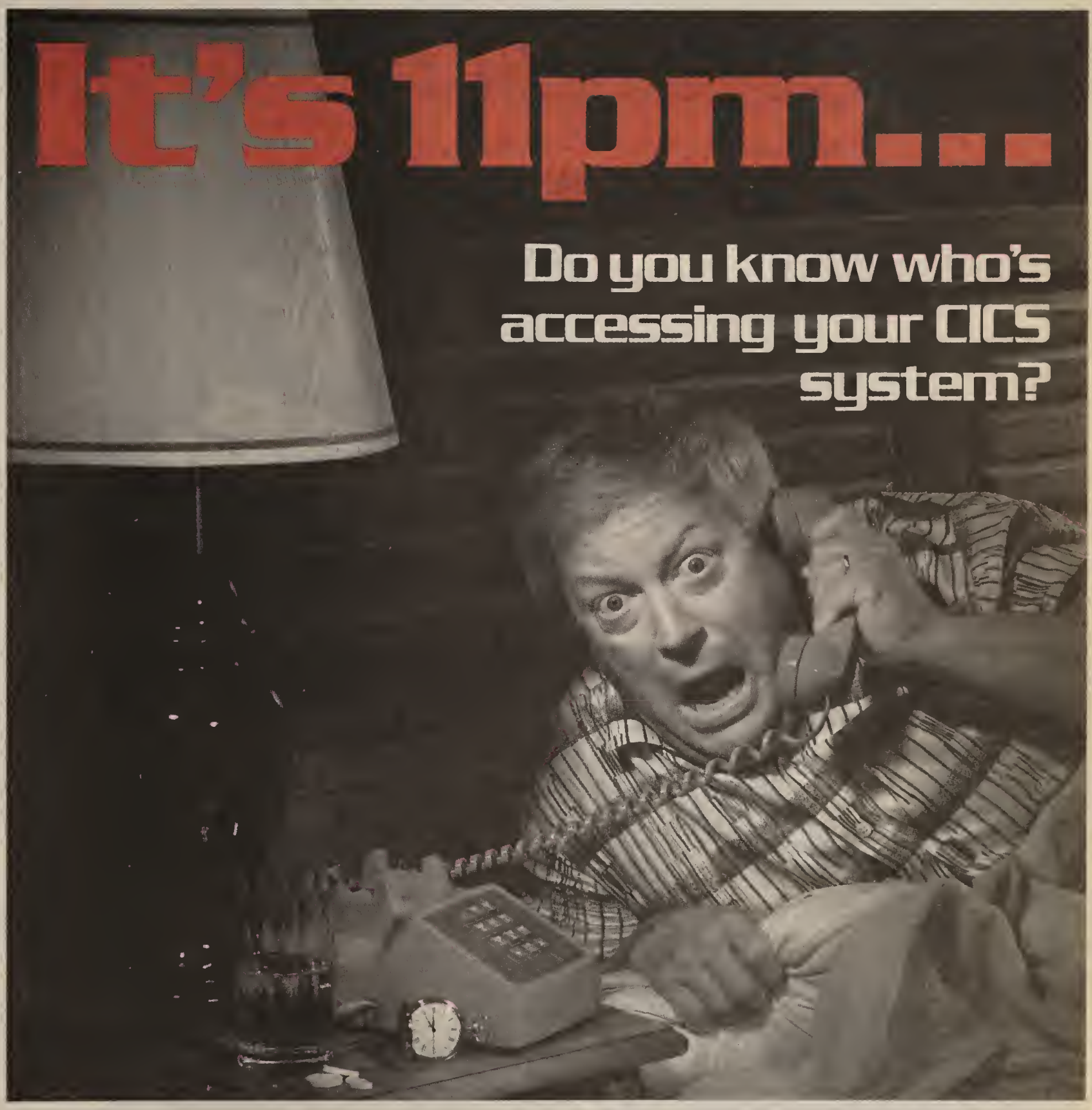

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NEW PRODUCTS/MICROCOMPUTERS

Continued from page 85

tal Products' standard DOS utilities. The Netcommander offers four, eight, 16 or 30 ports.

A four-port version of Netcommander costs $1,095, and an eight-port costs $1,695. The 16- and 30-port models cost $1,895 and $3,895, respectively. Easylan is priced at $80 per personal computer, and Blast costs $250 per connected personal computer or $895 for minicomputer installation.

Digital Products, 108 Water St., Watertown, Mass. 02172.

Storage

Disc Tech One, Inc. has announced the **RB Link** product line of desktop disk drive expansion unit subsystems that make the Digital Equipment Corp. Rainbow 100 series compatible with IBM Personal Computer hardware and software.

The RB Link series includes the RB Link, RB Link Jr. and RB Link Sr. The RB Link adds an expansion slot and allows the subsystem to run most IBM Personal Computer hardware and software. The RB Link Jr. includes a 48 track/in. floppy disk drive and two expansion slots. The RB Link Sr. provides file expansion slots and a 5¼-in. Winchester hard disk drive.

Prices for RB Link, RB Link Jr. and RB Link Sr. are $1,300, $800 and $3,800, respectively.

Disc Tech One, 849 Ward Drive, Santa Barbara, Calif. 93111.

■

Sysgen, Inc. has boosted the capacity of its **Smart Image** cassette streaming tape backup subsystem from 10M bytes to 20M bytes.

A tape controller board using very large-scale integration circuitry made the performance improvement possible, according to a spokesman.

Smart Image can work with IBM Personal Computers, Personal Computer XTs, ATs and compatibles. An internal version costs $795 while the external version is priced at $895.

Sysgen, 47853 Warm Springs Blvd., Fremont, Calif. 94539.

■

Systems Peripherals Consultants is offering the **Diskit** series of low-profile Winchester disk drives for computers that run on Digital Research, Inc. CP/M, IBM PC-DOS or Microsoft Corp. MS-DOS.

The drives are housed in 2-in.-high Pro/File cabinets that can be mounted on top of or alongside the computer. Diskit drives are available as primary on-line storage devices, in removable cartridge models as backup devices or as part of the Diskit Combo, where an additional drive is stored in the same chassis to provide 50M bytes of on-line storage.

Prices range from $1,095 to $1,995.

Systems Peripherals Consultants, 9747 Business Park Ave., San Diego, Calif. 92131.

COMMUNICATIONS

Controllers

Adaptive Computer Technologies has announced the **ACT 1200P** and the **ACT 2400P**, two data compression units.

The two units combine the data compression of Adaptive Computer's current product line with protocol support in a small desktop unit. Reportedly, the units permit 9.6K bit/sec. throughput using 2,400 bit/sec. full-duplex modems or 4.8K bit/sec. throughput using 1,200 bit/sec. full-duplex modems.

The ACT 1200P is priced at $695. The ACT 2400P is priced at $895.

Adaptive Computer Technologies, Suite 102, 97 Boston Ave., San Jose, Calif. 95128.

■

CWA International, Inc. has announced the **CWA 3805 Network Controller** for the IBM System/34, 36 and 38.

The controller performs terminal

Continued on page 88

Downtime. Uptime. In Time. Every Time. Six words that tell the story of quality service. Told by TRW, the company that lives by these words. Our principal business is the expert maintenance and repair of your system's hardware. Expertise you can rely on to reverse downtime to uptime. In time. Every time.

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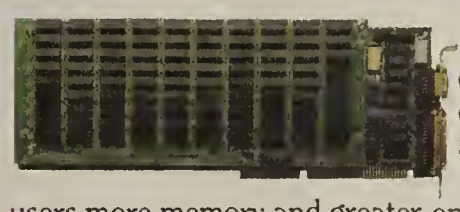

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concentration and relieves the host of all interactive communications processing. Multiple dial-up capability is supported, as is connection to IBM 5250 and 5249 control units.

The 3805 Network Controller is based on the IBM Series/1 with IBM's EDX operating system and other IBM-supported hardware. It is supplied as a bundled system solution.

Prices range from $50,000 to $142,000.

CWA International, Suite 210, 18805 Cox Ave., Saratoga, Calif. 95070.

Voice/data communications

Metapath, Inc. is marketing a 240-port data private branch exchange called **CDS-240** that is able to interconnect nearly any computer, terminal and peripheral containing an RS-232 serial or standard parallel interface.

The PBX switch supports 1,125 ports on a single network. It attaches up to 192 serial devices operating at 9.6K bit/sec. and 48 devices with parallel interfaces at 40K bit/sec.

Remote sites have the same port selection and queuing capabilities as local users with automatic timeout and logoff features. Security passwords prevent unauthorized access.

Prices start at $4,900 for a minimum configuration.

Metapath, 222 Lincoln Centre Drive, Foster City, Calif. 94404.

■

Opcom has announced the **Dial/DID** interface for direct inward dial (DID) trunks. It allows Opcom's Dial system to provide 24-hour, seven-day integrated secondary answering for private branch exchanges.

The interface allows Dial to inform a caller when a party is unavailable and then allows the caller to choose another extension or leave a message.

Dial/DID comes in a module containing one to three interface cards, each supporting eight trunks. Up to 20 modules can be installed, supporting a maximum of 480 trunks.

Dial/DID costs $3,500 for the first eight trunks and $1,500 for each additional eight trunks up to 24.

Opcom, 538 Oakmead Pkwy., Sunnyvale, Calif. 94086.

Protocol converters

Quasitronics, Inc. has announced the **Q-4220** RS-232/RS-422 protocol converter.

The converter is a device that provides bidirectional synchronous or asynchronous conversion of all commonly used RS-232 and RS-422 signals. Each port is jumper configurable for data terminal equipment or data communications equipment operation.

The unit was designed to be configured with one port set as data terminal equipment and the other port set as data communications equipment, according to the vendor.

The Q-4220 converter is priced at $219.

Quasitronics, 211 Vandale Drive, Houston, Pa. 15342.

Scitec Corp. has announced the **Scitec E_1-T_1** communications standard converter said to convert European CCITT G703 circuits to AT&T Bell Laboratories DS1 circuits.

The converter provides carrier frequency conversion of 1.544M bit/sec. to 2.048M bit/sec. with each interface conforming to electrical specifications for AT&T Bell Laboratories and CCITT diphase pulse transmission. It features four channels, expandable to 128.

The converter is priced from $10,000.

Scitec, 850 Aquidneck Ave., Middletown, R.I. 02840.

Software

Gammalink is offering **Gammafax**, a software package that enables its 9.6K bit/sec. Gammacomm modem board to communicate with Group III digital facsimile machines over dial-up telephone lines.

The package allows page images scanned by a facsimile machine to be sent to a personal computer and stored as disk files. In turn, ASCII files or graphics generated on the micro can be sent to remote facsimile machines.

Gammafax, which bundles the software with the Gammacomm modem board, lists for $2,490.

Gammalink, 2452 Embarcadero Way, Palo Alto, Calif. 94303.

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Then there are our extensive data bases used to help identify common problems

NEW PRODUCTS/COMMUNICATIONS

Netlink, Inc. has announced the **3711 SNA Gate**, the first of a family of IBM Systems Network Architecture (SNA) servers providing a generalized gateway from X.25 or any local-area network to SNA using IBM's Netbios interface.

The 3711 SNA Gate provides software to attach one personal computer card and its Netbios interface to the SNA Gate.

Asynchronous devices or personal computers attached to local nets or X.25 networks running asynchronous terminal emulators can connect to the SNA Gate and appear to IBM's SNA as a Logical Unit Type 1 or Logical Unit Type 2.

The 3711 SNA Gate can operate upstream to an SNA host at speeds up to 64K bit/sec.

Prices for the 3711 start at $11,100.

Netlink, 3214 Spring Forest Road, Raleigh, N.C. 27604.

Multiplexers/modems

ABM Computer Systems has unwrapped **Bright Modem**, a Hayes Microcomputer Products, Inc.-compatible 300/1,200 bit/sec. asynchronous modem for the IBM Personal Computer.

Bright Modem reportedly derives its intelligence from the Personal Computer's processor, rather than from an on-board dedicated processor, to allow for future extensions or alterations to the modem's instruction set via software upgrades to the driver.

Features include autoanswer and autodial in tone or pulse mode, according to the vendor.

The product is also said to have the capability to be configured as either COM1 or COM2.

Bright Modem is priced at $199.

ABM Computer Systems, 3 Whatney, Irvine, Calif. 92718.

Data General Corp. has announced its **Model 5095** time division multiplexer, which allows multiple terminals or devices to transmit simultaneously over a single high-speed communications line.

The Model 5095 is compatible with DG computer terminals. It supports data transmission speeds up to 9.6K bit/sec., local and remote terminal clusters and a mixture of RS-232 and RS-422 interface types.

The multiplexer interleaves eight individual lines into one high-speed composite line for serial transmission and operates at distances up to 2,000 ft using twisted-pair cable.

The Model 5095 is priced at $995.

DG, Route 9, Southboro, Mass. 01772.

■

Lantel Corp. has announced the **Lantel 168** central retransmission unit (CRU) and the **Lantel 500T** and **500DC** voice modems.

The 168 CRU is a single-channel frequency translator that allows the IBM PC Network to accommodate up to 1,000 personal computers. It allows the network to serve an area up to three miles wide on a standard broadband cable system.

The two modems allow broadband local-area network operators to add telephone capability to their networks. Dedicated voice ring down circuits are installed using two 500T modems.

The 168 CRU costs $1,495. The 500T and 500DC modems cost $895.

Lantel, 3100 Northwoods Place, Norcross, Ga. 30071.

■

Inmac Corp. has introduced **Data Cypher 384**, a security device for any terminal or personal computer that sends or receives information, and the **Clear Signal Smart 300-Baud Modem** for swapping data with local computers and accessing nearby data bases.

Data Cypher 384 uses code to scramble data for transmission over phone lines or directly onto tapes or disks. It plugs between any RS-232C-compatible terminal or personal computer and modem and operates at up to 38.4K bit/sec.

The Clear Signal Smart 300-Baud Modem offers autodial and autoanswer. It is Hayes Microcomputer Products, Inc. compatible and has a 25-pin female RS-232 connector and an RJ11 phone cord.

Data Cypher 384 is priced at $399; the Clear Signal Smart 300-Baud Modem costs $229.

Inmac, 2465 Augustine Drive, Santa Clara, Calif. 95054.

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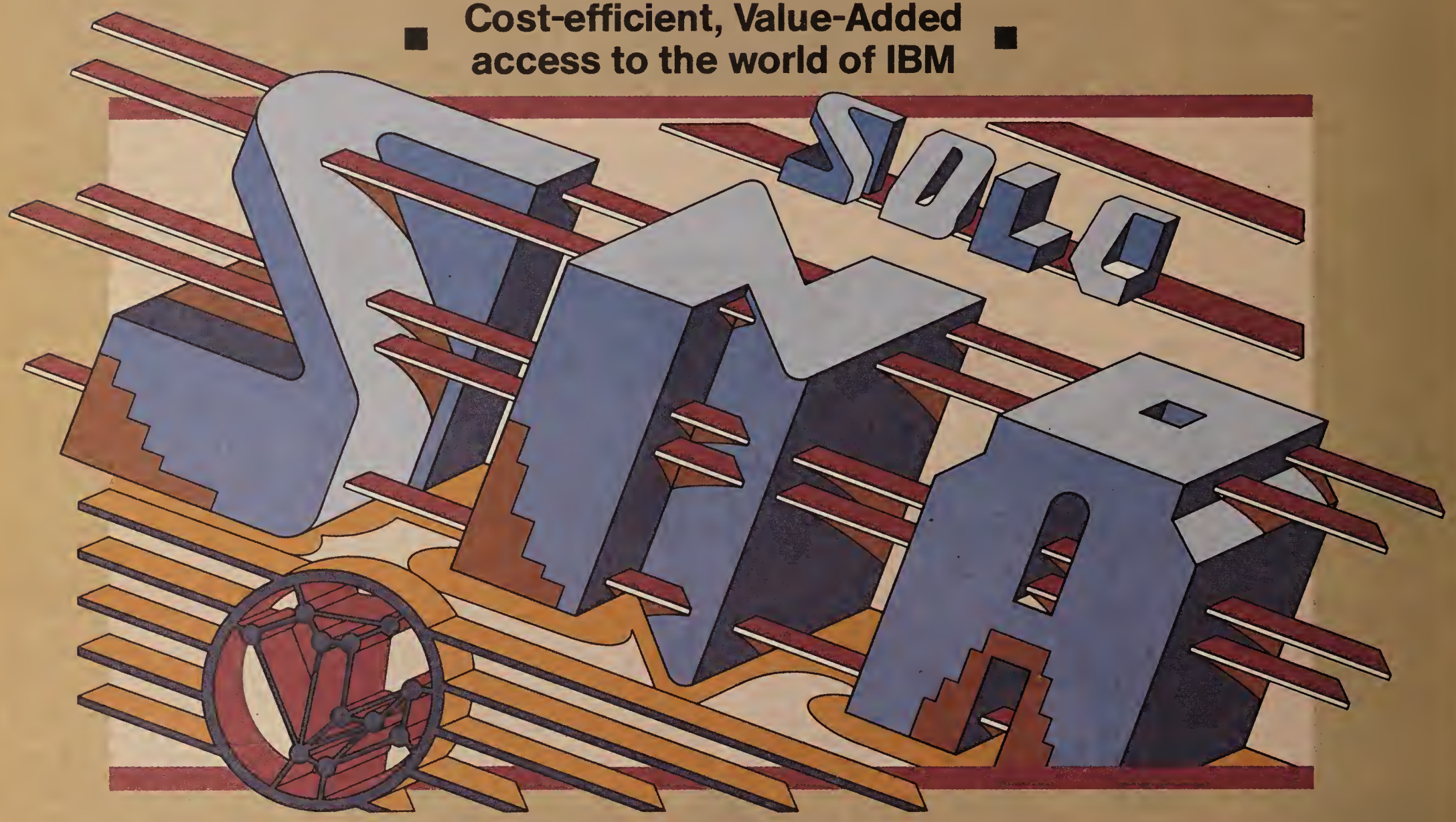

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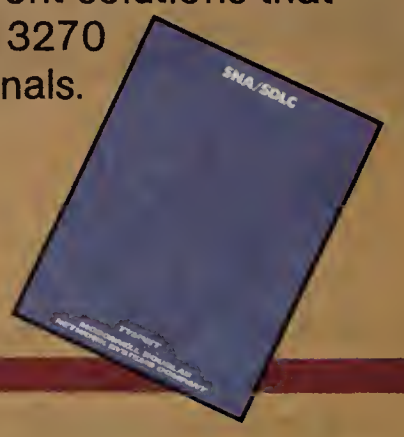

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Processors

Models 7865 and **7866**, two multifunction Intel Corp. 8088 CPU cards for the STD bus that offer an optional Intel 8087 math coprocessor, are available from **Pro-Log Corp**.

Model 7865 includes a dual serial communications controller that provides both an RS-232C interface and RS-422/RS-485 communications.

The second CPU card, the 7866, includes two 36-pin SBX connectors, an eight-level priority-interrupt controller and a software-selectable counter/timer.

Prices are $445 for the 7685 and $495 for the 7866.

Pro-Log, 2411 Garden Road, Monterey, Calif. 93940.

■

Mercury Computer Systems, Inc. has announced the **Megazip** modular parallel processing array processor designed for computationally intensive applications.

Megazip operates as a true coprocessing system, requiring very little involvement from the host computer.

The product can interface with IBM Personal Computer ATs as well as with systems from Masscomp, Motorola, Inc., Intel Corp., Sun Microsystems, Inc. and with Digital Equipment Corp. Q-bus.

Megazip offers up to five processing nodes. It features between four and 20 I/O ports.

Prices range from $20,000 for a single node to $90,000 for a five-node system.

Mercury Computer Systems, Wannalancit Technology Center, 600 Suffolk St., Lowell, Mass. 01854.

Data storage

Priam Corp. has added three 5¼-in. Winchester disk drives, **Models 617, 623** and **725**.

The average access time of Models 617 and 623 is said to be 18 msec. Model 617 offers 172M bytes, and Model 623 offers 234M bytes of unformatted storage capacity.

The 245M-byte Model 725 provides a 20-msec average access time. Its interface supports the ANSI X3T9.2 small computer systems interface standard for both extended and common sets.

The interface includes bus arbitration with disconnection and reconnection; host transparent defect mapping; a dual-port, 2M-byte disk data buffer; consecutive sector transfers; 32-bit error correction code; and asynchronous data transfers to 1.3M byte/sec.

Prices are $1,495 for Model 617, $1,795 for Model 623 and $1,995 for Model 725.

Priam, 20 W. Montague Expwy., San Jose, Calif. 95134.

Toshiba America, Inc. has announced the **MK-150** series of 5¼-in. Winchester disk drives available in 173M-byte, 121M-byte and 86M-byte capacities.

The drives provide an average random-access time of 25 msec and a 30,000-hour mean time between failure.

The first MK-150 drives will offer 20K bytes per track. They also provide a data transfer rate of 10M bit/sec.

Other features include dedicated head landing zone, automatic power down lock, mechanical crash stops, voice coil positioner with center stack servo and remote indicator capability.

Prices range from $1,295 to $1,695 in OEM quantities.

Toshiba America, #103, 3910 Freedom Circle, Santa Clara, Calif. 95054.

Toshiba America, Inc. has unveiled an 8-in. 337M-byte Winchester drive called the **MK-286F** that is said to provide an 18-msec access time.

An MK-280 series will be offered in two interface versions: an enhanced storage module device interface with a 1.8M byte/sec. transfer rate and a high-speed storage module device interface with a transfer rate of 2.4M byte/sec.

The MK-286F is priced at $3,400 in OEM quantities.

Toshiba America, #103, 3910 Freedom Circle, Santa Clara, Calif. 95054.

■

Amcodyne, Inc. has introduced the **Tomahawk 7130**, a rigid disk drive that provides a 27M-byte removable cartridge and 81M bytes of

Continued on page 92

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UNIX Fundamentals for Non-Programmers*		Mar 19-21 Jul 9-11 Sep 17-19	Mar 12-14 Jul 23-25	Jan 29-31 Apr 30-May 2 Oct 22-24	Mar 12-14 Jul 23-25	Feb 5-7 Apr 16-18 Aug 27-29	Jan 29-31 Apr 30-May 2 Oct 22-24	Jan 15-17 Mar 12-14 May 21-23 Jul 23-25 Oct 1-3 Nov 19-21	$735	
UNIX Fundamentals for Programmers*	Jan 15-17 Mar 12-14 Jun 4-6 Jul 30-Aug 1 Sep 24-26 Nov 19-21	Mar 31-Apr 2 Jul 14-16 Sep 22-24	Mar 17-19 Jul 28-30	Feb 3-5 May 5-7 Oct 27-29	Mar 17-19 Jul 28-30	Feb 10-12 Apr 21-23 Sep 8-10	Feb 3-5 May 5-7 Oct 27-29	Jan 20-22 Mar 17-19 Jun 2-4 Jul 28-30 Oct 6-8 Dec 1-3	$735	$1125
Shell as a Command Language*	Jan 20-21 Mar 17-18 Jun 9-10 Aug 4-5 Sep 29-30	Apr 3-4 Jul 17-18 Sep 25-26	Mar 20-21 Jul 31-Aug 1	Feb 6-7 May 8-9 Oct 30-31	Mar 20-21 Jul 31-Aug 1	Feb 13-14 Apr 24-25 Sep 11-12	Feb 6-7 May 8-9 Oct 30-31	Jan 23-24 Mar 20-21 Jun 5-6 Jul 31-Aug 1 Oct 9-10 Dec 4-5	$490	
'C' Language Programming*	Feb 24-28 May 12-16 Jul 14-18 Sep 8-12 Nov 3-7	Apr 7-11 Jul 21-25 Sep 29-Oct 3	Mar 31-Apr 4 Aug 4-8	Feb 10-14 May 12-16 Nov 3-7	Mar 31-Apr 4 Aug 4-8	Feb 17-21 Apr 28-May 2 Sep 15-19	Feb 10-14 Apr 12-16 Nov 3-7	Jan 27-31 Mar 31-Apr 4 Jun 9-13 Aug 4-8 Oct 13-17 Dec 8-12	$1225	
Shell Programming*	Jan 22-23 Mar 19-20 Jun 11-12 Aug 6-7 Oct 1-2	Apr 14-15 Jul 28-29 Sep 6-7	Apr 7-8 Aug 11-12	Feb 17-18 May 19-20 Nov 10-11	Apr 7-8 Aug 11-12	Feb 24-25 May 5-6 Sep 22-23	Feb 17-18 May 19-20 Nov 10-11	Feb 3-4 Apr 7-8 Jun 16-17 Aug 11-12 Oct 20-21 Dec 15-16	$490	$1125
Using Advanced UNIX Commands*	Jan 29-31 Apr 9-11 Jun 18-20 Aug 13-15 Oct 8-10 Dec 3-5	Apr 16-18 Jul 30-Aug 1 Sep 8-10	Apr 9-11 Aug 13-15	Feb 19-21 May 21-23 Nov 12-14	Apr 9-11 Aug 13-15	Feb 26-28 May 7-9 Sep 24-26	Feb 19-21 May 21-23	Feb 5-7 Apr 9-11 Jun 18-20 Aug 13-15 Oct 22-24 Dec 17-19	$735	
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Berkeley Fundamentals and 'csh' Shell*	Feb 3-7 Apr 14-18 Jun 23-27 Aug 18-22 Oct 13-17 Dec 8-12	May 12-16 Aug 25-29 Nov 3-7	May 5-9 Sep 15-19	Jun 23-27 Dec 15-19	Feb 3-7 May 5-9 Sep 15-19	Mar 31-Apr 4 Jun 9-13 Dec 15-19	Jun 23-27 Dec 15-19	Mar 3-7 May 5-9 Sep 15-19	$1225	

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Continued from page 91

fixed storage.

The 8-in. drive has three fixed disks and one removable rigid disk. The average access time is 25 msec. It is available in two versions, distinguished by either a storage module drive or a small computer systems electrical interface.

The Tomahawk 7130 with storage module drive interface is priced at $3,375 each in quantities of 500.

Amcodyne, 1301 S. Sunset St., Longmont, Colo. 80501.

■

Amdahl Corp. has added the **6300 Models AE4** and **BE4** to its 6000 series of storage products.

Both models contain four independent disk enclosures, each with a maximum storage capacity of 1,260M bytes of user data.

The purchase price for the 6380 Model AE4 is $104,110 and $78,510 for the 6380 Model BE4. A typical 20G-byte configuration, consisting of a 6880 Model G2 control unit, one 6380 Model AE4 disk storage unit and three 6380 Model BE4 disk storage units has a list price of $398,610, with monthly maintenance charges of $1,143.

Amdahl, P.O. Box 3470, 1250 E. Arques Ave., Sunnyvale, Calif. 94088.

Terminals

Human Designed Systems, Inc. has added four Digital Equipment Corp. VT220-compatible terminals, the **HDS2200**, **HDS220G**, **HDS221** and the **HDS221G**, to its HDS200 family of display terminals.

The HDS220 is an ANSI standard terminal. The HDS220G has graphics capabilities including 720- by 350-pixel resolution, Tektronix, Inc. 4010/4014 emulation and local printer support. The HDS221 and HDS221G add the APL character set and keyboard and have the capability of generating APL overstruck characters.

All four offer a 15-in. monitor.

Pricing for the HDS220, HDS220G, HDS221 and HDS221G is $995, $1,295, $1,295 and $1,595, respectively.

Human Designed Systems, 3440 Market St., Philadelphia, Pa. 19104.

Printers/plotters

JDL, Inc. has announced the **JDL-750E**, a color dot matrix printer for engineering workstations.

The 750E prints at speeds of 100 char./sec. in letter-quality mode and 180 char./sec. in draft mode. Graphics are available in 14 colors. Resolution is 180 by 180 dot/in. with letter-quality resolution at 180 by 360 dot/in.

Six character fonts can be resident simultaneously, with up to four additional fonts downloaded.

The product has a standard parallel interface and supports an optional serial interface.

The single-quantity price is $1,850.

JDL, Suite 104, 2801 Townsgate Road, Westlake Village, Calif. 91361.

Microtek Lab, Inc. has unwrapped two document scanners, the **MS-300** and **MSF-300**, that offer up to 300 dot/in. resolution.

Other resolutions — such as 240 dot/in. to match the IBM 3820 Page Printer — are available through an on-line scaling process. The MS-200 can also scan documents at 200 dot/in. allowing page makeup, Group III facsimile or optical character recognition applications involving 10-point or larger typefaces.

The scanners perform Group III CCITT one-dimensional data compression at an average 10:1 ratio for text and graphics.

There are three interface options: parallel, RS-442 and RS-232C.

Single-unit prices are $2,300 for the MS-300, including scanner unit, interface kit and driver program, and $1,700 for the MS-200.

Microtek Lab, 16901 S. Western Ave., Gardena, Calif. 90247.

■

Recognition Equipment, Inc. has announced the **Beam Reader** bar-code scanner.

The Beam Reader uses a nonlaser LED visible light source.

The product can be configured with devices including point-of-sale terminals, personal computers, data entry terminal and portable data collection units.

The Beam Reader bar-code scanner and decoder electronics module is priced at $995.

Recognition Equipment, P.O. Box 660204, Dallas, Texas 75266.

Sharp Electronics Corp. has announced the **JX-720** compact color ink-jet printer.

The printer has four ink cartridges that can be combined to produce up to 256 basic colors. It accommodates either 8½- by 11-in. cut sheets, overhead transparencies or roll paper.

It connects to office and personal computers through a Centronics Data Computer Corp. parallel interface and has a printing resolution of 120 dot/in. The number of printed dots can be adjusted to produce halftones for color images up to 8½ in. wide.

The JX-720 costs $1,495.

Sharp Electronics, 10 Sharp Plaza, Paramus, N.J. 07652.

■

Epson America, Inc. has introduced the **FX-286**, a 136-col. dot matrix printer.

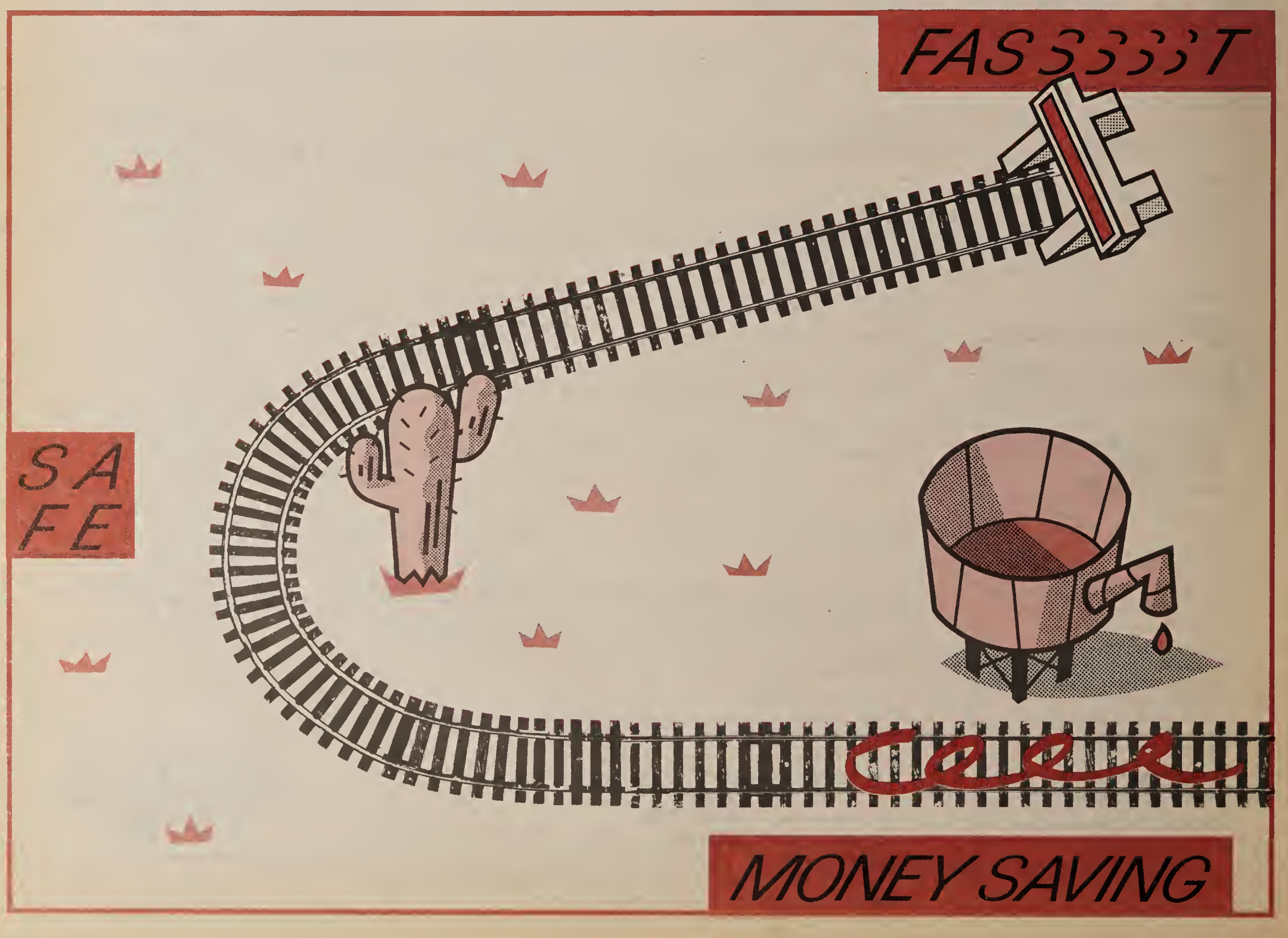
It offers both 9- by 9-dot draft-quality characters and 18- by 18-dot near-letter-quality characters. In draft mode it prints at a rate of up to 200 char./sec. In near-letter-quality mode the rate is 40 char./sec. The FX-286 can emulate the IBM 4201 Proprinter.

It has an 8K-byte buffer and can mix graphics with text in 136-col. printouts.

The product offers six character pitches and over 160 type-style combinations.

The FX-286 is priced at $749, including both friction and tractor paper feed.

Epson America, 2780 Lomita Blvd., Torrance, Calif. 90505.



NEW PRODUCTS/SYSTEMS & PERIPHERALS

General Business Technology, Inc. has introduced the **5227FA**, a 120 char./sec. forms access matrix printer.

The 5227FA combines an adjustable pin-feed platen with a tear bar to allow instant removal of printed forms without advancing the paper or wasting the next form. Another feature is its character font flexibility.

It connects directly to the IBM System/34, 36 and 38 either locally or at remote IBM 5251 Model 12 or 5294 sites.

The 5227FA is priced at $1,995.

General Business Technology, 1891 McGraw Ave., Irvine, Calif. 92714.

■

Syntest Corp. has announced the **SP-700** 40-col. printer.

The SP-700 has two-color capability along with 1.5 line/sec. throughput. It features RS-232C or 20-mA data input at 150 to 9.6K bit/sec., double-width printing, data or text mode printing with ASCII command and mechanical dimensions of 10.3 by 7.25 by 3.9 in.

The printer is priced at $385.

Syntest, 40 Locke Drive, Marlboro, Mass. 01752.

Power supplies

Two power conditioner line regulating transformers for protecting computers, peripherals and other electronic equipment from power line irregularities — the RV-250 and the RV-550 — are available from **Perma Power Electronics, Inc.**

The conditioners combine the functions of a voltage stabilizer, surge suppressor and radio frequency and electromagnetic interference noise filter. Offered in 225VA and 550VA models, they respond to power line voltage changes even if the incoming voltage sags as low as 95V or rises as high as 130V.

They protect equipment from transient spikes and surges up to 6000V, filter radio frequency and electromagnetic interference noise. The conditioners handle power interruptions of up to 3 msec.

Prices are $179 for the RV-250 and $359 for the RV-550.

Perma Power Electronics, 5615 W. Howard Ave., Chicago, Ill. 60648.

■

Marconi Instruments has added the **6919** 75-ohm impedence power sensor to its line of detectors used with its 6960 Digital and 6950 Analog power meters.

The 6919 sensor, with a 50db dynamic range from -30 dBm to +20 dBm, covers the frequencies from 30 KHz to 3 GHz.

The product enhances the range capability by providing a sensor with a robust 75-ohm N-type connector. The 6919 is well suited for power measurements in the areas of cable television, video and telecommunications equipment.

The 6919 costs $695.

Marconi Instruments, 3 Pearl Court, Allendale, N.J. 07401.

Board-level devices

DY-4 Systems, Inc. has announced the **SVME-716**, an intelligent I/O controller that can support Pertec Computer Corp.-compatible 9-track streaming and start/stop tape drives.

The SVME-716 contains a Motorola, Inc. 68000 CPU with 128K bytes of dynamic random-access memory, a Motorola 68450 multichannel direct memory access controller and the interface electronics for the tape drives.

Features include power-up controller diagnostics, data scatter/gather commands, support for up to eight drives and transfer rates up to 320K byte/sec.

The SVME-716 is priced at $2,100.

DY-4 Systems, Suite 202, 1475 S. Bascom Ave., Campbell, Calif. 95008.

■

Emulex Corp. has announced the **QD21** and the **DM01** disk controllers.

The QD21 interfaces two industry-standard serial-mode enhanced small disk interface 5¼-in. Winchester disk drives to Digital Equipment Corp.'s Q-bus.

The QD21 implements DEC's MSCP protocol on the Microvax I and II, Micro/PDP-11 and LSI-11 computers.

The DM01 interfaces a Q-bus CPU with two ST506/412 5¼-in. Winchesters and one or two floppy disk drives while implementing MSCP. It supports direct memory access data transfers in 16-, 18- and 22-bit addressing modes as well as block-mode transfers.

The QD21 costs 1,295; the DM01 costs $1,295.

Emulex, P.O. Box 6725, 3545 Harbor Blvd., Costa Mesa, Calif. 92626.

■

Distributed Logic Corp. has introduced the **DQ142** tape coupler for use with Digital Equipment Corp. LSI-11 and Micro/PDP-11 computers.

The DQ142 provides switch-selectable direct memory access burst size and a 4K-byte first-in first-out buffer. It allows virtually any type of 9-track, ½-in. magnetic tape drive into an LSI-11 system.

Each DQ142 is contained on a single quad-size printed-circuit board.

The price is $1,260.

Distributed Logic, P.O. Box 6270, 1555 S. Sinclair St., Anaheim, Calif. 92806.

■

Computrol, a division of Kidde Automated Systems, Inc., has added the **Megalink Q-100**, a Digital Equipment Corp. Q-bus-compatible board, to its family of Megalink interfaces.

The Q-100 is a dual-board set that interfaces either Computrol's FM Coaxial Modem or Computrol's Redundant Multidrop Fiber-Optic Modem. It supports up to 2M bits of direct memory access block transfers between computers. It can be networked with up to 99 other compatible megalinks.

Q-100 units are priced at $1,825 in quantities of 100.

Computrol, 15 Ethan Allen Highway, Ridgefield, Conn. 06877.

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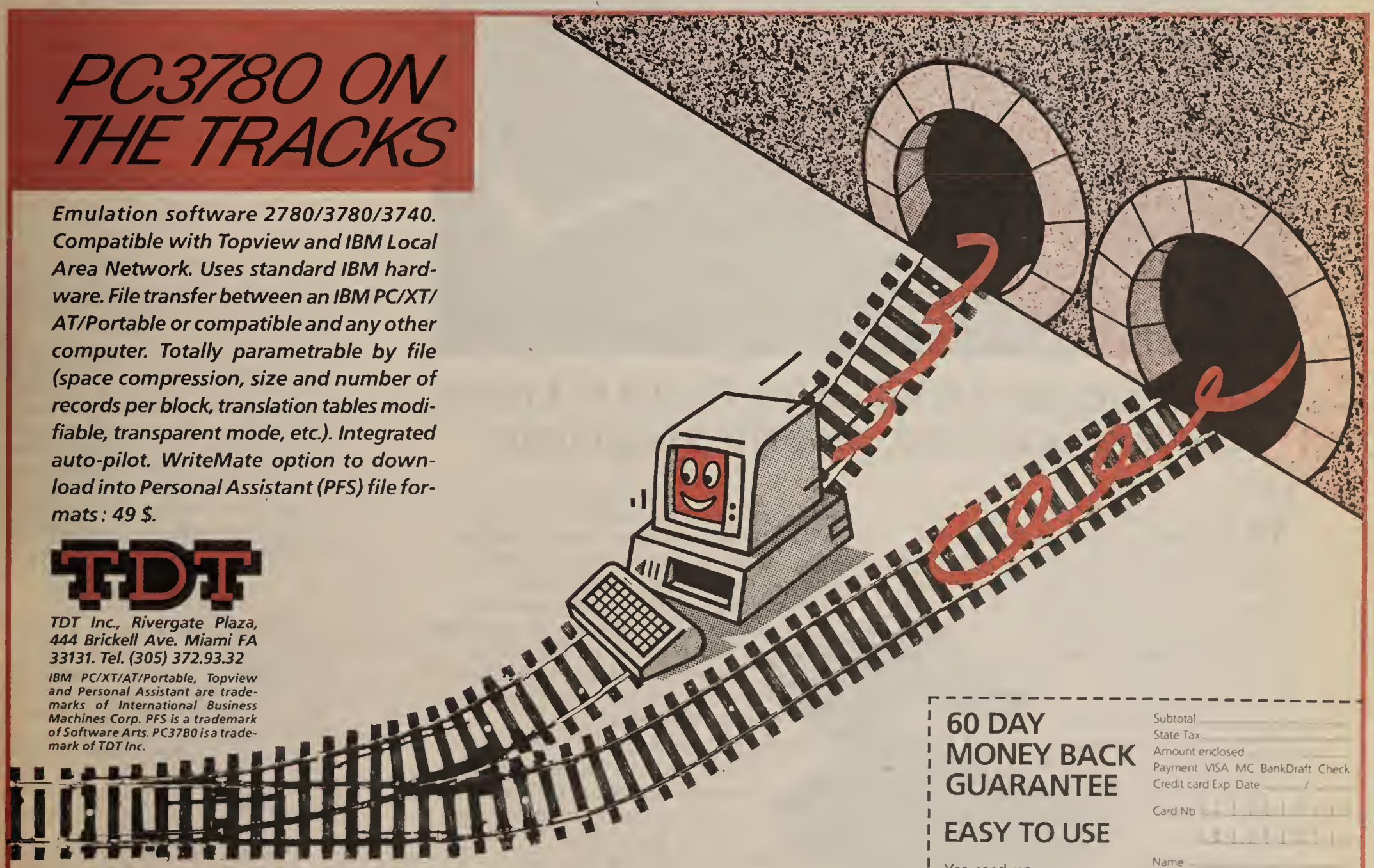

TDT

TDT Inc., Rivergate Plaza, 444 Brickell Ave. Miami FA 33131. Tel. (305) 372.93.32

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EDITIS

ILC Data Device Corp. has announced the **BUS-65508** MIL-STD-1553 Intel Corp. Multibus interface card.

The interface card includes dual redundant bus controller, remote terminal unit and bus monitor functions, an ILC Data Device representative said.

The BUS-65508 provides an intelligent interface between a 1553 serial multiplexer data bus and a parallel Multibus, according to the representative.

The product reportedly includes a 4K-byte by 16-bit memory as well as six subsystem command registers and four types of subsystem interrupts.

The BUS-65508 is priced from $7,695.

ILC Data Device, 105 Wilbur Place, Bohemia, N.Y. 11716.

Dynatem introduced the **RM65-2112E** math coprocessor module for RM 65 bus systems.

The module uses the AM9511A devices that perform fixed-point 16- and 32-bit operations or 32-bit floating-point operations.

The module is user assignable to a single page of address space within either of the two 64K-byte banks provided by the RM 65 bus.

Model RM65-2112E costs $390.

Dynatem, 19 Thomas, Irvine, Calif. 92718.

■

EMC Corp. has announced the **HXP-604** 4M-byte memory said to double the memory capacity for Hewlett-Packard Co. HP 3000 computers, Models 64 and 68 and the **MVXII-8MB** add-in memory card for the Digital Equipment Corp. Microvax II.

The HXP-604 allows users to exceed the current 8M-byte memory limit of the systems.

The MVXII-8MB provides 8,192K bytes of additional memory. It supports parity checking and all other memory system features of the Microvax II.

The HXP-604 is available with instructions that enable the systems to address the additional memory for $25,500. The MVXII-8MB costs $6,500.

EMC, 12 Mercer Road, Natick, Mass. 01760.

Auxiliary equipment

Inmac Corp. has introduced the **Signal Pro T-Switch** and the **Security Monitor.**

The Signal Pro T-Switch is designed to enable computer terminal users to share laser printers, modems, plotters and other peripherals. It uses printed-circuit boards in an all-aluminum case. The serial version has a built-in data line surge suppressor.

Five models are available: two for 25-line RS-232 devices, two for 36-line Centronics Data Computer Corp. devices and one for 25-line IBM devices.

The Security Monitor tracks power, temperature and noise levels around the clock. If it detects a problem it calls to report it. It hooks directly to a telephone line. The user can also call the monitor to check conditions.

The price for the Signal Pro T-Switch ranges from $169 to $329. The Security Monitor costs $249.

Inmac, 2465 Augustine Drive, Santa Clara, Calif. 95054.

PRICE REDUCTIONS

Printronix, Inc. has announced a price reduction on its **Laserprint-20**.

The Laserprint-20 was designed as an additional line printer for minicomputer and mainframe environments requiring a high-duty cycle of more than 100,000 pages per month.

The new cost is $11,995 with no per-page maintenance charge.

Printronix, P.O. Box 19559, 17500 Cartwright Road, Irvine, Calif. 92713.

■

Forte Communications has reduced the price on its **Fortegraph** micro-to-mainframe graphics products.

Fortegraph S3G, including a Forte PJ communications board, now costs $1,995. The cost for an upgrade to an existing PJ board is $995. Fortegraph for the Digital Communications Associates, Inc. Irma communications board costs $995.

Forte Communications, 2205 Fortune Drive, San Jose, Calif. 95131.

■

Integrated Business Computers has announced that it is increasing the standard memory on its **System-68** and lowering the price.

The memory is being increased from 1M to 2M bytes. The price is dropping from $15,995 to $13,995. The standard system includes 16 serial I/O ports, one parallel port, one 5¼-in. 55M-byte hard disk drive, one 8-in. floppy disk drive and 2M bytes of random-access memory.

Integrated Business Computers, 21621 Nordhoff St., Chatsworth, Calif. 91311.

■

Southern Data Systems, Inc. has announced price reductions on its **DMX** family of memory products for the Wang Laboratories, Inc. Wang 2200 and its **SDS-Extended Basic-2** operating system releases.

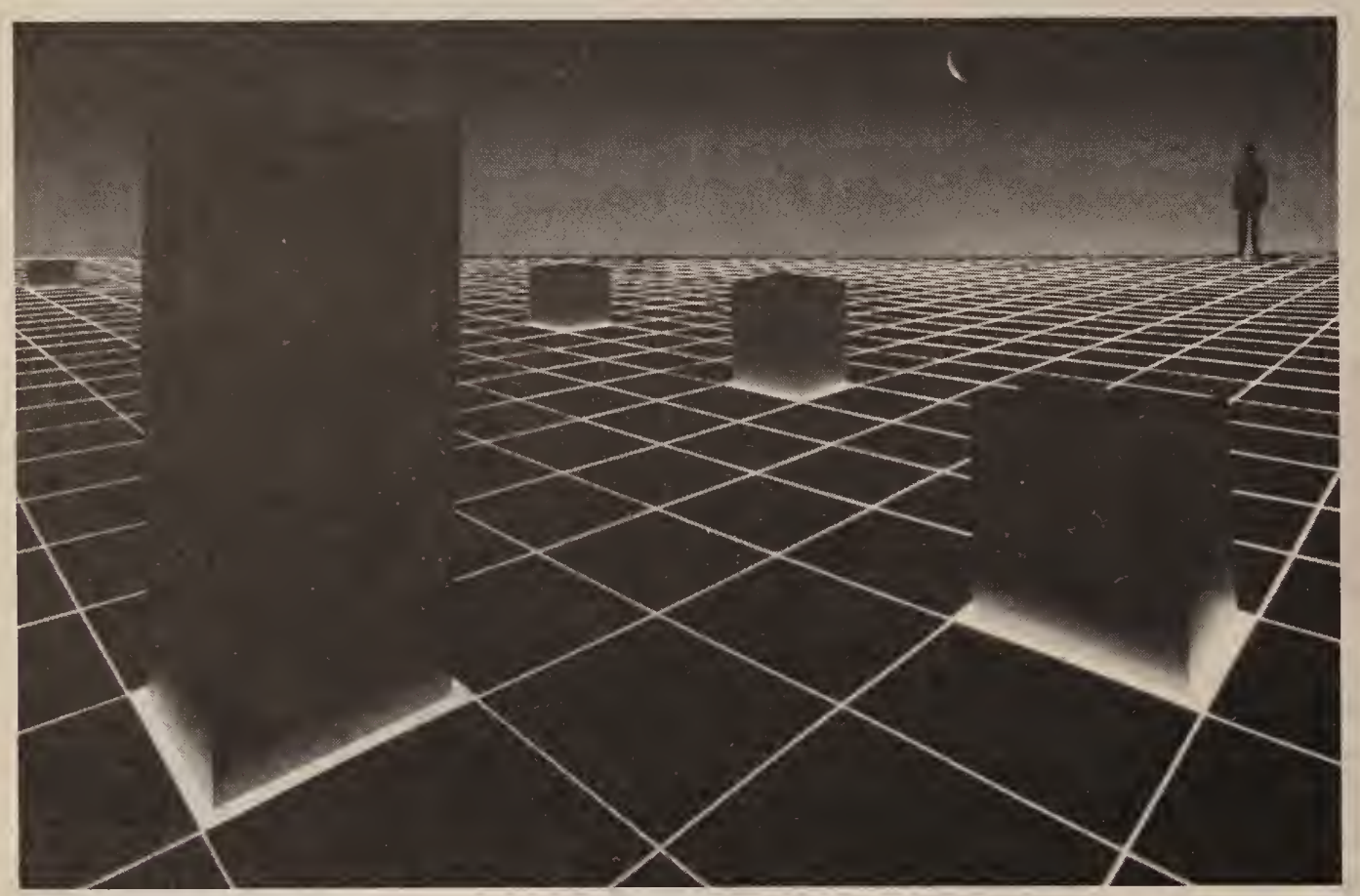
The DMX memory family, SMI-128K, DMI-256K, DM2-512K and DM4-1MB, are now priced at $450, $900, $1,600 and $2,700, respectively.

Release 2.7 of the SDS-Extended Basic-2 enhanced operating system now costs $149.

Release 2.8 has been reduced to $249.

Southern Data Systems, P.O. Box 31192, Raleigh, N.C. 27622.

Before we can share ideas, we have to share information.



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The poly-SHARE program's breadth of appeal is matched by its ease of use. It provides a menu interface, on-line help and fully automatic transfers of library entries to and from PCs. And it's available for both ALL-IN-1 and standard VMS configurations.

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Willowdale, Ont., 416/495-0008

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To enhance the performance of **Sync-Up** modems, UDS offers two custom software packages — **Sync-Up** "Dial" and **Sync-Up** "BSC." "Dial" exercises complete control of the device until connection with the remote modem is achieved; control is then shifted to the RS-232C interface. "BSC" is the ideal package for micro-to-mainframe or micro-to-micro communication, since it fully emulates either a 2780/3780 or a 3270 terminal.

For full details and quantity prices on the **Sync-Up** hardware/software packages, contact UDS today. Universal Data Systems, 5000 Bradford Drive, Huntsville, AL 35805. Telephone 205/837-8100; Telex 752602 UDS HTV.

QUANTITY ONE PRICES	201C	208A/B
With "Dial" Software	$685	$1200
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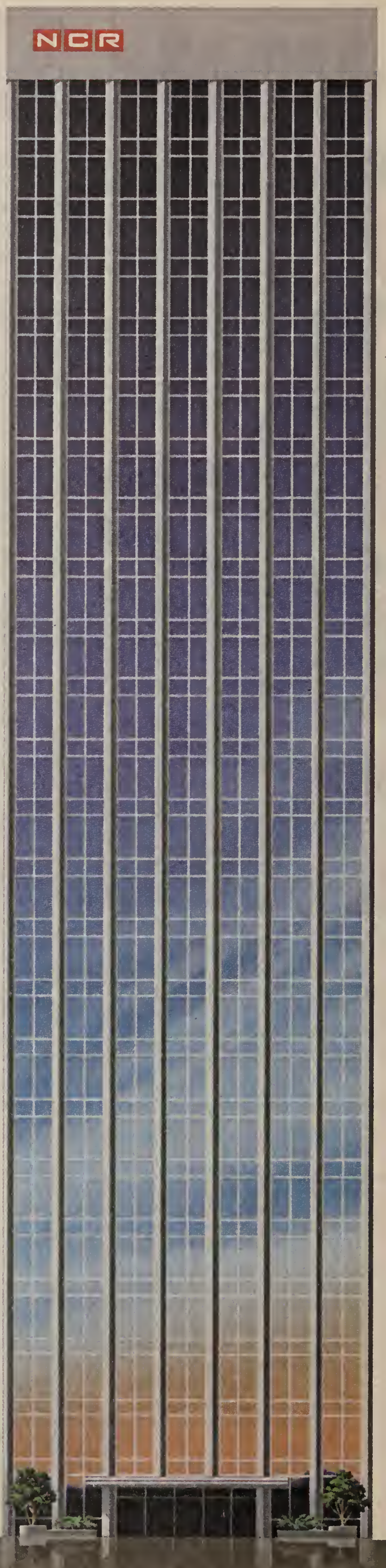
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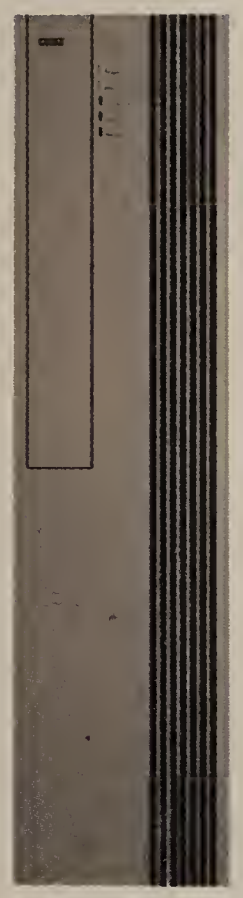
IF YOU LIKE WHAT'S INSIDE THE TOWER 32, YOU'LL LOVE WHAT'S BEHIND IT.

The NCR OEM Systems Division introduces the Tower® 32: Up to three times faster than the Tower XP. Memory capacity of up to 16MB, with an amazing 14MB per program. SCSI (Small Computer System Interface) providing up to 4GB of mass storage. Connectivity for up to 32 users and a host of industry standard interfaces. An NCR-enhanced UNIX* operating system. And more.



That's a lot to like.

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And, Tower upgradeability means that as your customers grow, so can their Tower system. Painlessly. With minimum software investment, minimum support investment. Maximum return on your Tower investment.

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NCR

OEM Systems Division, NCR Corporation, U.S. Data Processing Group, USG-1, Dayton, OH 45479. Nationwide (800) CALL NCR.

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NEWS

CALENDAR

WEEK OF FEB. 2

FEBRUARY 3-6, CINCINNATI — **Fourteenth Annual ACM Computer Science Conference and Employment Register.** Contact: Orrin E. Taulbee, Association for Computing Machinery, Department of Computer Science, University of Pittsburgh, P.O. Box 13526, Pittsburgh, Pa. 15243.

FEBRUARY 3-6, LAS VEGAS — **AFCOM's 6th Annual Uniforum.** Contact: Usr/group International Network of Unix Users, Suite 200, 4655 Old Ironsides Drive, Santa Clara, Calif. 95054.

FEBRUARY 3-7, DALLAS — **Writing Procedures, Policies and Documentation.** Contact: Mary Ann Cluggish, Information Mapping, Inc., 275 Wyman St., Waltham, Mass. 02154.

FEBRUARY 3-7, MONTEREY, CALIF. — **ATI '86 — Seventh Annual Symposium on Automation Technology, CAD/CAM and Engineering Data Handling.** Contact: Jeff Smith, American Technology Institute, Inc., P.O. Box 242, Pebble Beach, Calif. 93953.

FEBRUARY 4-7, ANAHEIM, CALIF. — **Third Annual Uniforum.** Contact: / Usr/group International Network of Unix Users, Suite 200, 4655 Old Ironsides Drive, Santa Clara, Calif. 95054.

WEEK OF FEB. 9

FEBRUARY 9-12, ORLANDO, FLA. — **American Bankers Association's 1986 Telecommunications and Financial Networks and Video Banking III Conferences.** Contact: Linda Gustavson, ABA Operations Group, 1120 Connecticut Ave. N.W., Washington, D.C. 20036.

FEBRUARY 10-11, WASHINGTON, D.C. — **Writing Management Reports.** Contact: Mary Ann Cluggish, Information Mapping, Inc., 275 Wyman St., Waltham, Mass. 02154. Also being held Feb. 25-26 in Somerset, N.J.

FEBRUARY 11-12, NEW YORK — **IBM's Master Plan, 1986-1990.** Contact: Yankee Group, 14th Floor, 89 Broad St., Boston, Mass. 02110.

WEEK OF FEB. 16

FEBRUARY 16-19, AUSTIN, TEXAS — **The DCEA Conference: Desktop Computers in Engineering and Architecture.** Contact: Donna Passons, University of Texas, 727 E. 26th St., Austin, Texas 78705.

FEBRUARY 18-19, SAN JOSE, CALIF. — **Institute of Electrical and Electronics Engineers, Inc. 1986 Annual Meeting.** Contact: IEEE Annual Meeting Department, 10th Floor, 345 E. 47th St., New York, N.Y. 10017.

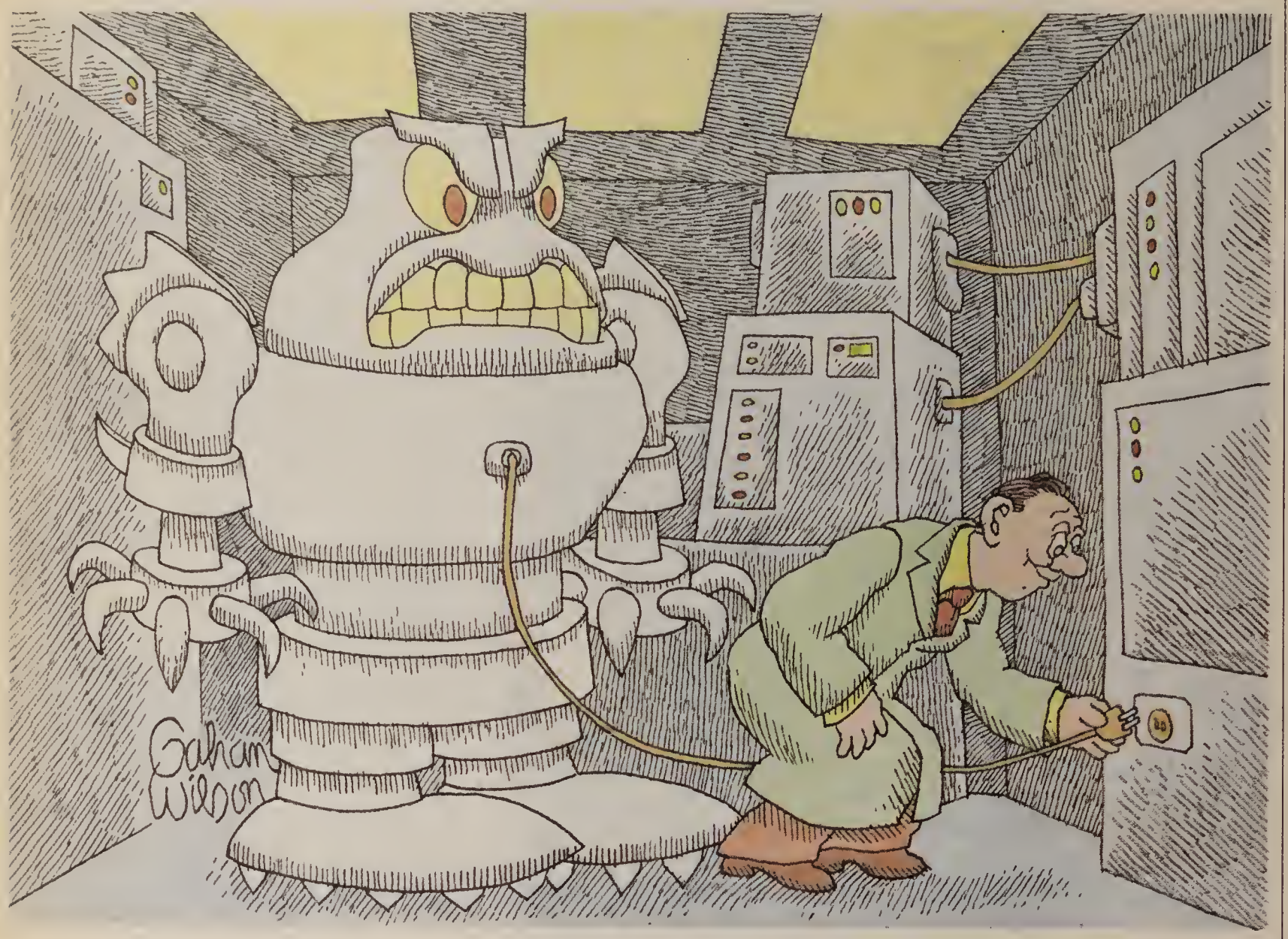
FEBRUARY 20, LONDON — **Europe Invitational Computer Conference Series.** Contact: Beatrice Labbe-Anderson, International Conference Director, Invitational Computer Conference, No. C-2, 3151 Airway Ave., Costa Mesa, Calif. 92626. Also being held Feb. 25 in Frankfurt and Feb. 27 in Zurich.

WEEK OF FEB. 23

FEBRUARY 23-26, SAN FRANCISCO — **Seventh Structured Development Forum.** Contact: Garant and Associates, Seventh Structured Development Forum, 45 Via Navarro, Greenbrae, Calif. 94904.

FEBRUARY 26, DEDHAM, MASS. — **Marketing Strategies/Marketing Communications.** Contact: Frank R. Trocki, Graphic Arts Program, Northeastern University, Center for Continuing Education, 370 Common St., Dedham, Mass. 02026.

FEBRUARY 27, FORT LAUDERDALE, FLA. — **U.S. Invitational Computer Conference.** Contact: Suzanne Hubner, U.S. Conference Director, Invitational Computer Conference, No. C-2, 3151 Airway Ave., Costa Mesa, Calif. 92626.



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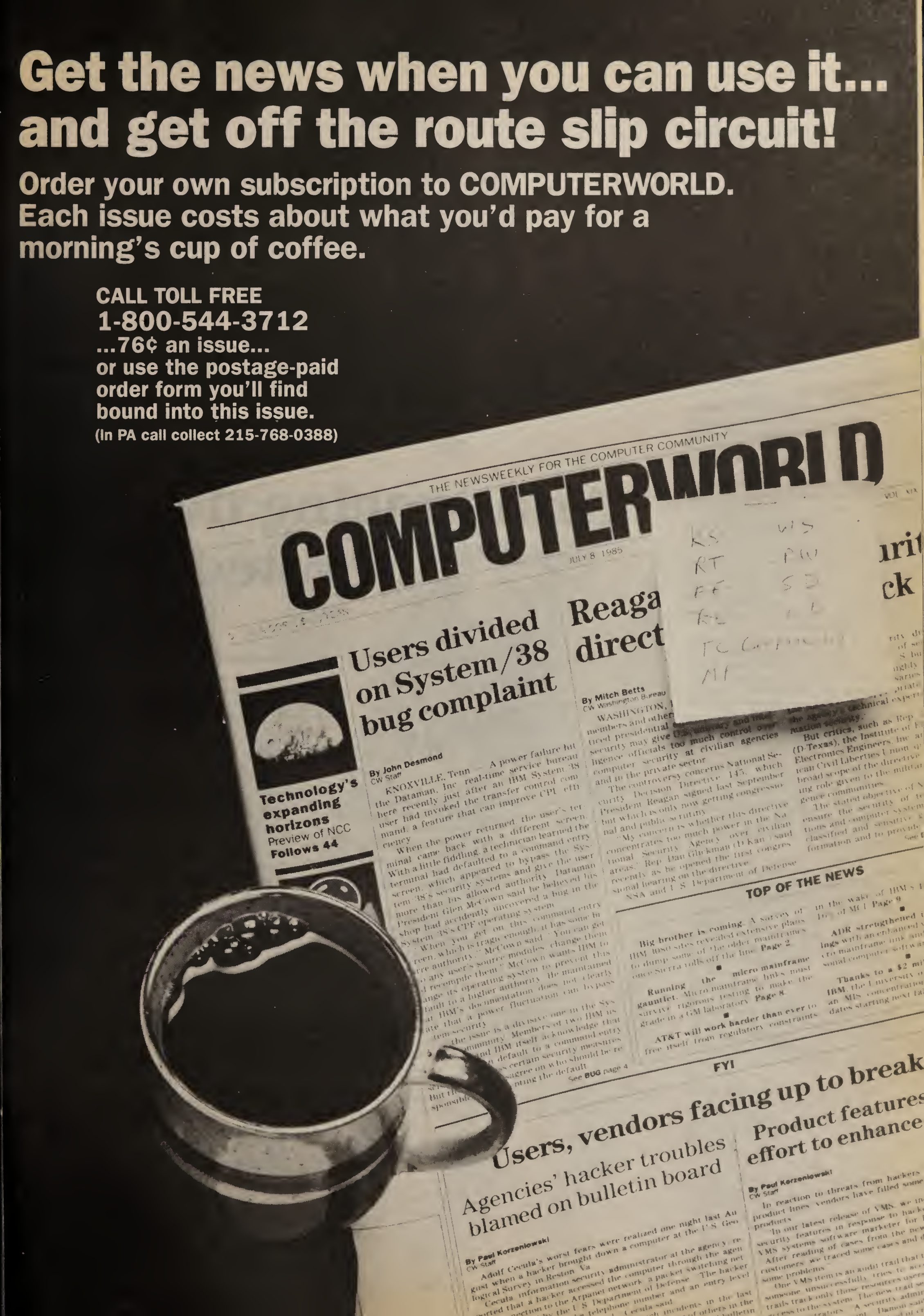


Exec typifies rise of independents

From page 134

tive role in defining and advocating the independent software industry," said Patrick J. McGovern, chairman of CW Communications, Inc., which publishes *Computerworld*. McGovern has known Goetz for 20 years.

Goetz, a beaming, diffident man who refuses to have a space reserved in the company parking lot, has been the technical leader of ADR since it was founded in 1959.

"I am very happy. I always wanted to be in charge of my own destiny, to work for a small company and be able to participate in its growth," Goetz said recently during lunch near his Princeton, N.J., office.

With the acquisition by Ameritech, ADR will lose some of its independence, he conceded, "but we've acquired long-term viability."

In a year in which profits have evaporated and stock values have slumped, there were worse possible fates, and Goetz and the ADR directors were keenly aware of them.

As a company's shares decline in value, it becomes an easier target for an unfriendly takeover. ADR felt uneasy on this point because several other software companies have been swallowed up by corporations hungry for their expertise, and the number of ADR shares controlled by insiders had shrunk.

ADR has a generous stock option plan — 400 of its 1,800 employees receive options each year. Stock issued under the plan plus additional public offerings had diluted the control of major inside shareholders from 40% of the company to less than 10%. "My own share, which started out at 14%, is now below 5%," Goetz said.

Another factor weighing on ADR management was the heavy institutional ownership of ADR stock. Sixty percent of the stock is owned by institutional investors, who react to quarterly results and have few barriers to accepting tender offers, friendly or otherwise.

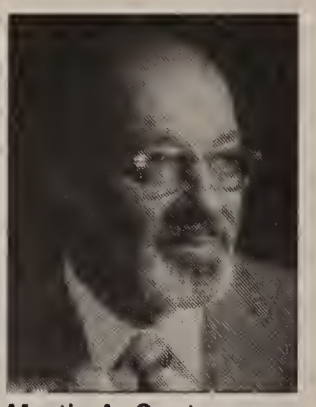
The Lord Abbett & Co. Develop and Grow mutual fund in New York owns 300,000 shares of ADR, and its managers watched its value drop to $15 5/8 earlier this year before Ameritech offered $32 a share. "When the price of a stock doubles almost overnight, it tends to be a happy event," a Lord Abbett spokesman said.

An additional factor, Goetz said, was IBM's new aggressiveness. ADR has been selling software to IBM customers for years, but today's buyers of data base management products are concerned about the longevity of the companies with which they do business.

By agreeing to the Ameritech acquisition, ADR gained a strong financial partner that was obligated by Judge Harold Greene's Second Computer Inquiry decision to maintain ADR as an independent subsidiary, Goetz pointed out.

To get to the point where it would be an attractive takeover target, ADR had to take the lead in developing products for an unproven market, challenge IBM's practice of bundling software with hardware and compete head to head with IBM for sales.

ADR started out writing custom software for such computer manufacturers as RCA Corp., Bendix Corp. and Sperry Corp. In 1964 ADR, which had the free nighttime use of an RCA 501, created Autoflow to draw 501 program flowcharts automatically. It attempted to market it to the 100 users of the 501, but only two customers materialized, leaving ADR with its modest development costs uncovered.



Martin A. Goetz, president of ADR

ADR rewrote the program for users of the IBM 1401 and 1410, a more lucrative market. Although IBM was bundling a competing product, IBM Flowcharter, Goetz claimed it had far less capability. He wrote to IBM complaining that they were misrepresenting their product and hurting ADR's market by giving the software away.

ADR proceeded to sell 2,000 copies of Autoflow, making it a successful product in the fledgling independent software industry, but found itself again at odds with IBM after bringing out Roscoe, its on-line programming environment. ADR was seeking niches where it would not have to compete head to head with IBM, but without knowing what IBM was developing, it could never be sure that its products had a future, Goetz said.

"You can't build a business with products so good they can compete with something for free," he noted. "I started speaking out against the unfair competition of bundled software."

In 1968, the U.S. Department of Justice initiated antitrust proceedings against IBM, and in April 1969, ADR sued IBM for monopolizing the software marketplace. Two months after the ADR filing, IBM announced that it would unbundle most systems software, and it settled the lawsuit with ADR for $2 million, Goetz recalled.

A succession of system software products followed, and now ADR, with $128 million in revenue in 1984, is completing a second addition to its building in a former cornfield outside of Princeton.

Goetz said that the acquisition by Ameritech will help ADR's long-term development capabilities, and he intends to be around for many years "to continue to grow them."

Announcing the only devoted to the

Sponsored by MACWORLD, the Macintosh Magazine, January 16-18, 1986 Brooks Hall and Civic Auditorium, San Francisco

The Macworld Exposition returns to San Francisco for the second annual gathering of all the products and services for the Macintosh computer.

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Products and services from companies such as Apple, Odesta, General Computer and Corvus will be on display. The show also features a special hands-on area with dozens of Macintoshes for everyone to use.

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Day one is for dealers, distributors, retailers, and other third-party vendors to talk to Apple and the 100+ exhibiting companies about their products.

Days two and three are specifically geared for people interested in the Macintosh as a tool for business and anyone else interested in the Mac.

Who should attend?

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Here's a sampling of what you will learn at the Macworld Expo:

- What software is available for the Macintosh for use in the office, school and home
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- How to get the most mileage out of desktop publishing
- Tips on using the Macintosh in small businesses
- Tips on using the Macintosh in large organizations
- The advantages of networking
- Getting the most out of spreadsheet programs

The Macworld Exposition is produced by World Expo Company and managed by Mitch Hall Associates.
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MACWORLD EXPOSITION
SAN FRANCISCO

Survey shows user confidence in ADR's Ideal

Vendor initiated study to counteract criticism

PRINCETON, N.J. — Applied Data Research, Inc. (ADR) said users gave its fourth-generation language and data base management system a strong vote of confidence in a survey commissioned recently by the software firm.

The survey, conducted by Input, Inc., a Mountain View, Calif., market research firm, found that 75% of the users said they believe the Ideal fourth-generation language can replace Cobol and PL/I for most of their backlogged applications.

According to the survey, eight out of 10 users said they experienced a doubling of productivity over Cobol. One in six said they gained productivity of 10 times or more.

ADR officials said the survey was initiated "to counteract some recent articles that questioned the effectiveness of applications written in fourth-generation languages, including Ideal."

ADR's Ideal and its Datacom/DB relational data base management system were mentioned in recent *Computerworld* stories on implementation snafus at the New Jersey Department of Motor Vehicles and in a report on fourth-generation languages [CW, Sept. 30; Oct. 14; and Nov. 11].

The respondents had an average of 14 months personal experience with Ideal, and 97% said Ideal ranged from "easy" to "very easy" to use. Eighty-six percent said Ideal was "effective" to "very effective" for prototyping.

Users rated Ideal's performance in large-volume applications at 3.7 on a scale of one to five. More than 80% said they would recommend Ideal to another data processing professional.

ADR gave Input the names of 200 users of Ideal; the firm surveyed 80 of the users, who were promised anonymity for their responses.

— Charles Babcock

Federal bids now closed to Paradyne

WASHINGTON, D.C. — The U.S. Department of Health and Human Services has barred Paradyne Corp. from all government business, pending resolution of the federal indictment against the Largo, Fla.-based company for fraud [CW, Dec. 23].

The action prohibits Paradyne from bidding on any federal contracts or federally approved subcontracts for an indefinite period. It does not affect Paradyne's current government business, including its 5-year-old contract with the Social Security Administration (SSA) on which the indictment was based.

A Florida grand jury charged that Paradyne and seven of the company's top officials conspired to bribe SSA officials to win the lucrative data communications terminals contract in 1981. Other allegations include fraud, false testimony before the SSA and obstruction of justice.

The SSA had already renewed the contract with Paradyne for support of its installed terminals for $12.4 million in 1986. But Paradyne will be prohibited from bidding for data communications equipment contracts for the SSA's processing center in Baltimore.

A Paradyne spokesman said approximately 10% of the firm's revenue comes from federal contracts, with the SSA contract accounting for approximately half of that.

— Clinton Wilder

computer show Macintosh™

Here are some of the companies who will be showing Macintosh products:

A+/Ziff-Davis Publishing
A.P.P.L.E. Co-op
Abaton Technology Corp.
Abvent
Activenture Corp.
Activision
Addison-Wesley Publishing
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Aldus Corp.
Altsys Corp.
Ann Arbor Softworks, Inc.
Apple Computer, Inc.
Applied Logic Systems
Applied Micronetics
Applied Micro Solutions
Apropos Software
Assimilation, Inc.
Association of Apple 32 Users
AST Research
Australian Pavillion
Avantec, Inc.
Avenue Software
Bay Systems
Beck-Tech
Berkeley Macintosh Users Group
Best Computer Supplies
Blackhole Technology
Blyth Software
Boston Computer Society
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Diversions
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Forethought, Inc.
Fortnum Software
Gemini Software
General Computer Corp.
Great Wave Software
GTCO Corporation
Hayden Book Co.
Hayes Microcomputer Products
High Performance Systems, Inc.
I/O Design, Inc.
Icon Publishing — The MACazine
Icon Review
inCider
Infosphere
Innovative Data Design
Innovative Technologies Communications
Integrated Support
Iomega Corp.
The Kette Group Inc./MacNifty Central
Knowledge Engineering
Kurta Corporation
Layered, Inc.
Levco Enterprises
Lisa/Mac XL Orphanage
Living Videotext
LoDown
Lotus Development Corp.
MacLord Systems, Inc.
MacMarketer/Mac Buyer's Guide
MacMemory Electronics
MACohm Projects
MacPherson
MacSink, Inc.
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Manhattan Graphics
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Mentauris Technologies
Micah, Inc.
Micro Design
Micro Planning Software
Microsoft Corp.
MicroStore
Microtech International
Micro-W Distributing, Inc.
Miles Computing
Mindscape, Inc.
The Model Office Co.
MPH Computer Products
Musicworks
Network Consulting, Inc.
Networkers
New Line 7
Nolo Press
Odesta Corp.
ODS, Inc.
Optimum Computer Luggage
Paladin Software
Palantir Software
Palo Alto Shipping
Panamax
Paradise Systems
Paragon Courseware
PBI Software
Peripheral Land
Personal Computer Peripherals
Personics Corp.
Prometheus Products
ProVUE Development
Quark
Scan-Co-Furn
Scholastic, Inc.
Semaphore Corp.
Sensible Software
Signal Video, Inc.
Silicon Beach Software
Sofcom Distributors
SoftIdea
SoftView
Softworks Limited
Spectrum Holobyte
Stanford University Mac Users Group
Step-Lively Software
Studio City/MacChannel
Summagraphics
Sunol Systems
SuperMac
T/Maker Graphics
Test Data Systems
TML Systems
TPS Electronics
Trans American Exchange
Type/Setting Net/Work, Inc.
Understanding Macintosh
Washington Apple Pi
Western Automation Laboratories, Inc.

(As of December 16, 1985)

Consulting firm cuts staff by 15%, refocuses strategy

NATICK, Mass. — In an effort to focus more on the development of networking software products, Software Research Corp. dismissed 15% of its work force last week.

The cuts primarily affected employees in its consulting and services division.

Chief Executive Officer Paul Tucker said the layoff of 18 of the firm's 120 employees did not result from a poor financial performance last year, although he did acknowledge that "small companies like us get impacted from the industry downturn.

From consulting to packaged software

"Consulting was the basis of this company, but, let's face it, packaged software is where we're going," Tucker said.

Privately held Software Research was founded in 1978 to provide network-related consulting services to vendors developing IBM-compatible equipment. It began marketing packages such as Docupower in 1984.

Tucker said the cutback came about when he had pinpointed "who was contributing to the mainstream and who was not."

Most 132 column terminals are designed to crunch a lot of numbers.

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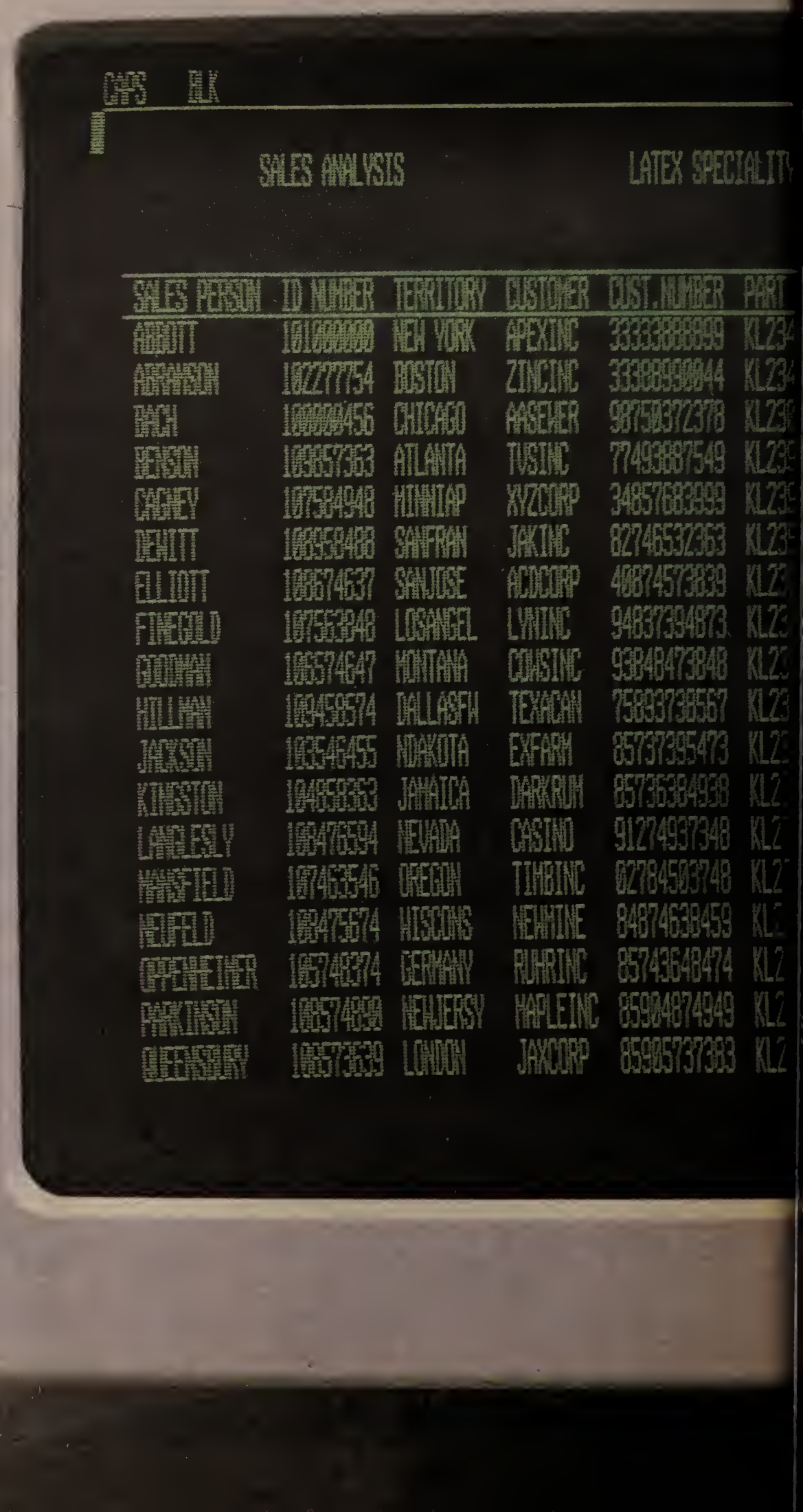
(Photo actual size)



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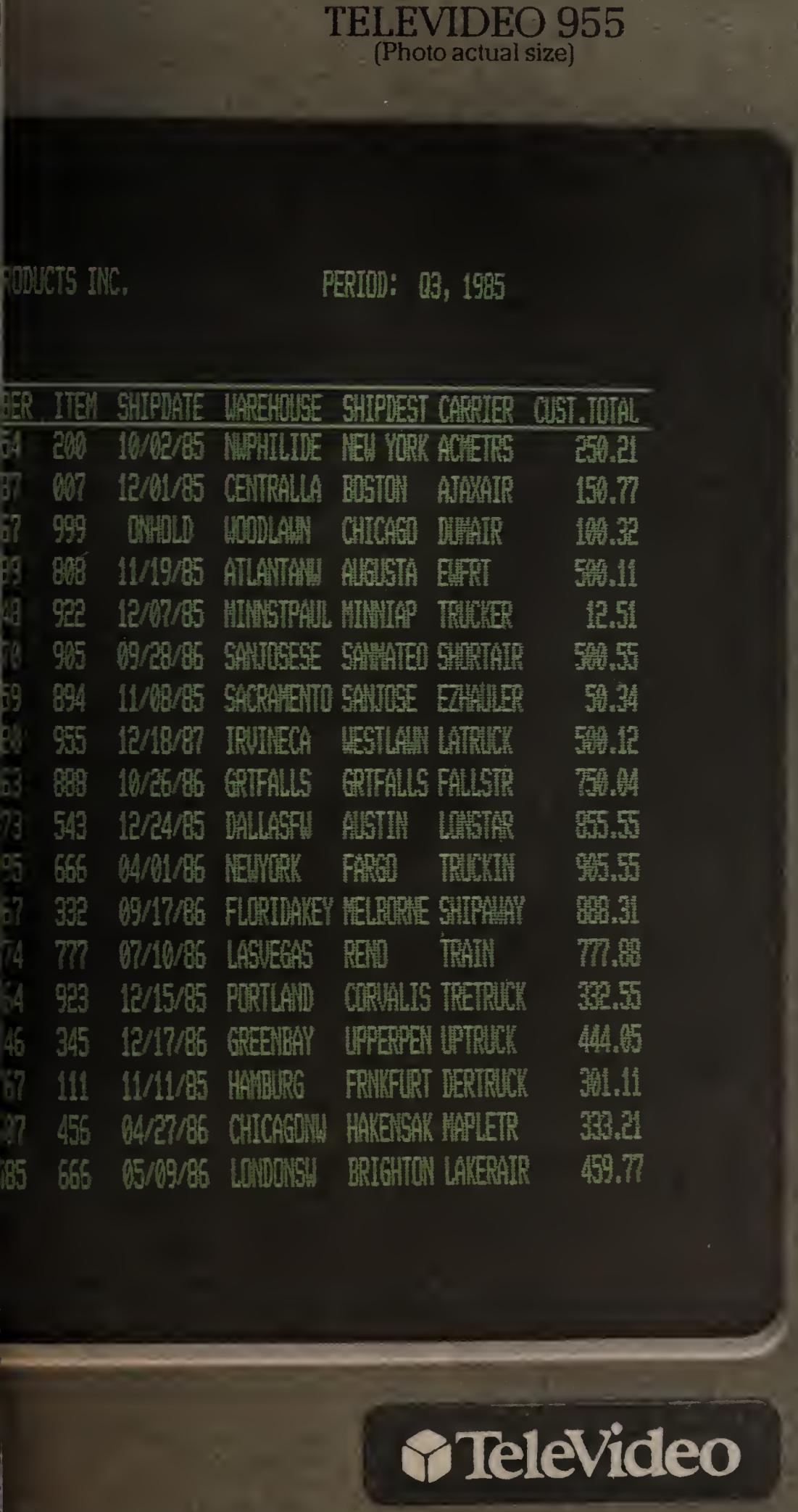
(Photo actual size)



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Industry mulls omens for '86

From page 134

The bright side, however, is that modest profits should return to firms that swallowed hard and retrenched within the last 12 turbulent months.

Such indications are already apparent at Apple Computer, Inc. and possibly at Data General Corp. Whether that will constitute an industry upturn or not is really a matter of semantics; it might be more accurate to call it a maturing, the result of a painful year when a high-flying industry suddenly fell back to earth.

■

It doesn't have a television commercial outtake on the cover or Macintosh lovers' testimonials in the back pages as in recent years, but the Apple Computer annual report released last week is stylish as well as blunt and pointedly drew on the company's own line of products to produce it.

"1985 was a turbulent year" is the understated first line; and it appears on the cover, at that. "We had to take swift action," the report noted of the second straight year in which Apple's earnings have dropped (to $61.2 million, just less than the earnings were in the then-record fiscal year 1982). "We did," the jacket copy continues, "and it's working."

Some of that swift action is chronicled in reproduced, obviously Macintosh-created memos from January through June. The memos outline the company's reorganization, which eventually led to the departure of the remaining of its two founders, Steve Jobs.

The only direct reference to Jobs' ouster is in a paragraph of the shareholders' letter by President and Chief Executive Officer John Sculley.

It refers to Jobs as "a brilliant young entrepreneur and one of our cofounders, who ceased to hold management responsibility for the Macintosh Division when it was absorbed into the Product Operations Group as part of the major reorganization in June. Steve subsequently resigned as Chairman of the Board, taking a handful of employees with him to found a new company. With regret, the Board of Directors felt it had to take legal action against Steve. We will pursue this action only so far as is necessary to protect the interests of our company and our shareholders."

In the gray pages at the back, the report lists steadily growing net sales of $1.9 billion, slightly increased research and development spending of $72.5 million, a nearly tripled increase to $337 million in cash assets, an increased $550 million in shareholders' equity and a 99 cent per share earning, the lowest since 1981.

Apple's fiscal year ended Sept. 27. Its annual meeting of shareholders will be Jan. 20, in Cupertino, Calif. And the Super Bowl, another traditionally significant date for Apple, is Jan. 26.

■

In the "What happened to that rumor?" department: Is AT&T still shopping for a computer company?

"The Convex C-1 system is the affordable answer for the supercomputer community. We have enhanced the C-1 system for Cray compatibility — the technology is truly impressive."

— Frank Greene President, ZeroOne Systems, Inc., Supercomputer Integrator and Computational Services Manager for NASA Ames and for the John von Neumann Supercomputer Center.

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— Steve Wallach
VP Technology, Convex Computer Corporation

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The C-1 supercomputer, which Convex is now shipping in volume, provides 64-bit integrated scalar and vector processing, an optimizing, vectorizing FORTRAN '77 compiler, the UNIX™ operating system, full interactivity, and is a general purpose, stand alone machine. ZeroOne Systems offers the C-1 with Cray compatibility, both as a stand alone system or in a front-end configuration. Most applications are ideally suited for the C-1 — it has a compute-intensive kernel with extensions provided for asynchronous I/O and disk striping for I/O intensive applications. Finally, the C-1's networking capabilities maximize the system's flexibility either as a computational server, as a front end to a Cray, or as a stand alone interactive real time analysis engine.

For more information on the C-1 system and its available software, contact: Convex Computer Corporation, 701 N. Plano Road, Richardson, TX 75081, 214 952-0200.

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Telenet denies sabotage charge, files countersuit

By Bryan Wilkins

CHICAGO — The American Medical Association (AMA) and GTE Telenet Communications Corp. have filed countersuits against each other stemming from the AMA's charge that GTE Telenet sabotaged an on-line medical information service sponsored by the association.

The AMA alleges that GTE Telenet, the public packet-switching data communications subsidiary of GTE Corp., based in Reston, Va., deliberately sought to damage the AMA's medical information service business, called Minet, which is distributed via Telenet to 10,000 physicians across the country.

The AMA said that Telenet, in a letter dated Oct. 31, informed the association that it planned to discontinue "virtually all of the data bases that Telenet agreed to market."

The AMA filed the original suit in December, seeking $15 million in damages.

GTE Corp. filed its countersuit last week, denying the AMA allegations and seeking $23 million in compensatory damages and $50 million in punitive damages.

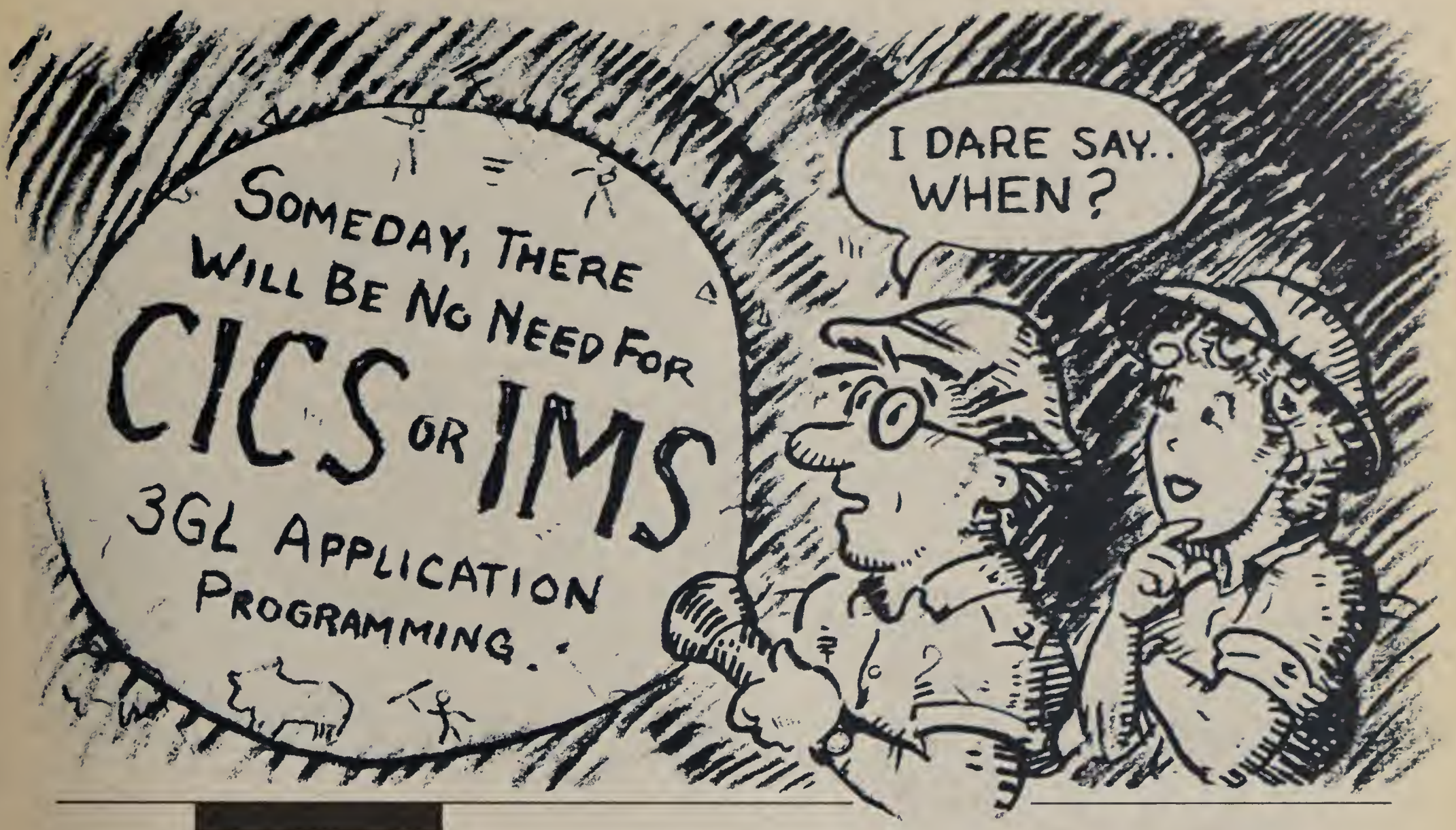
Allegations are baseless

"We are surprised by the lawsuit. We have been working in good faith, working with the the users of Minet to address the mutual concerns in its operations. The allegations are baseless," Telenet said in a statement.

The AMA further charged that Telenet "orally threatened to assign some or all of its contract obligations without the AMA's consent."

Telenet and AMA agreed to join forces four years ago to develop and market medical information data bases as well as a computer-based information retrieval system to store and disseminate medical information. The system was originally called Infotrak and then Minet.

The AMA suit said Telenet's effort to halt distribution of Minet was not legal because the costs used to justify termination were misidentified, and "the cost and revenue data relied upon by Telenet are the direct result of Telenet's own breaches."



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National Semi losses down

Tax credit increases second-quarter figures

By Maura McEnaney

SANTA CLARA, Calif. — National Semiconductor Corp. reported a loss of $34.8 million, or 41 cents per share, during the second quarter ended Dec. 15, bringing losses for the first half of the year to $88 million. The losses compare with profits of $8.5 million for the same quarter a year ago.

Sales for the second quarter were $782.7 million, down from $964.4 million during the same period in 1984.

National Semiconductor's third consecutive quarterly loss, reduced by a $2.1 million tax credit, comes in lower than the previous quarterly loss of $53 million.

Capital spending at National Semi was slashed to $15 million in the second quarter from $128 million during the second quarter 1984. For the first half of this fiscal year, capital expenditures were approximately $60 million, compared with $231.7 million during the same period a year ago.

National Semiconductor President Charles Sporck said "Until our semiconductor order rates show strength for a prolonged period, our financial performance will remain under pressure."

Modest computer growth predicted

From page 134

would increase 17% and semiconductor industry sales would increase 16%, but both predictions proved to be too optimistic.

The expected 1986 rebound still falls short of historical trends for the high-tech industries. The computer industry grew at a 23% rate — compounded annually — from 1977 to 1982; and the semiconductor industry grew at a 19% rate over the same time period, with a growth spurt of 43% from 1983 to 1984.

The projections assume greater economic growth in 1986 than in 1985. However, the Commerce Department based its 648-page annual forecast on the Reagan administration's assumption that the country's real gross national product (GNP) will increase 4%, a growth rate that private economists consider optimistic. A National Association of Business Economists poll of 300 members predicted GNP growth of 2.9%.

A substantial part of U.S. computer shipments in 1986 will come from existing large inventories, the report added, so industry employment will show little growth in 1986.

The agency predicted the following trends for 1986:

■ **Mainframes.** The mainframe sector should recover from its relatively flat 1985 as many new models reach the market. The value of U.S. shipments should increase 13% to $18 billion. Sales of mainframe software will increase 25% to $5.1 billion, partly spurred by demand for data base management software.

■ **Minicomputers.** Superminicomputer firms will continue to benefit from strong demand for the latest high-performance offerings. As a result, shipments of all types of minicomputers should increase 18% to $14 billion. The outlook for packaged software for minis also appears favorable, with a projected increase of 28% to $8.7 billion.

■ **Microcomputers.** The microcomputer industry should experience a year of moderate growth in 1986. The value of micro shipments will rise 18% to $12 billion, while the number of units shipped will increase 12% to 5 million units. Many of the factors that caused slower industry growth in 1985 will persist, including the postponement of purchases by businesses. Demand for micro software should remain strong, pushing software revenues up 37% to $3.7 billion.

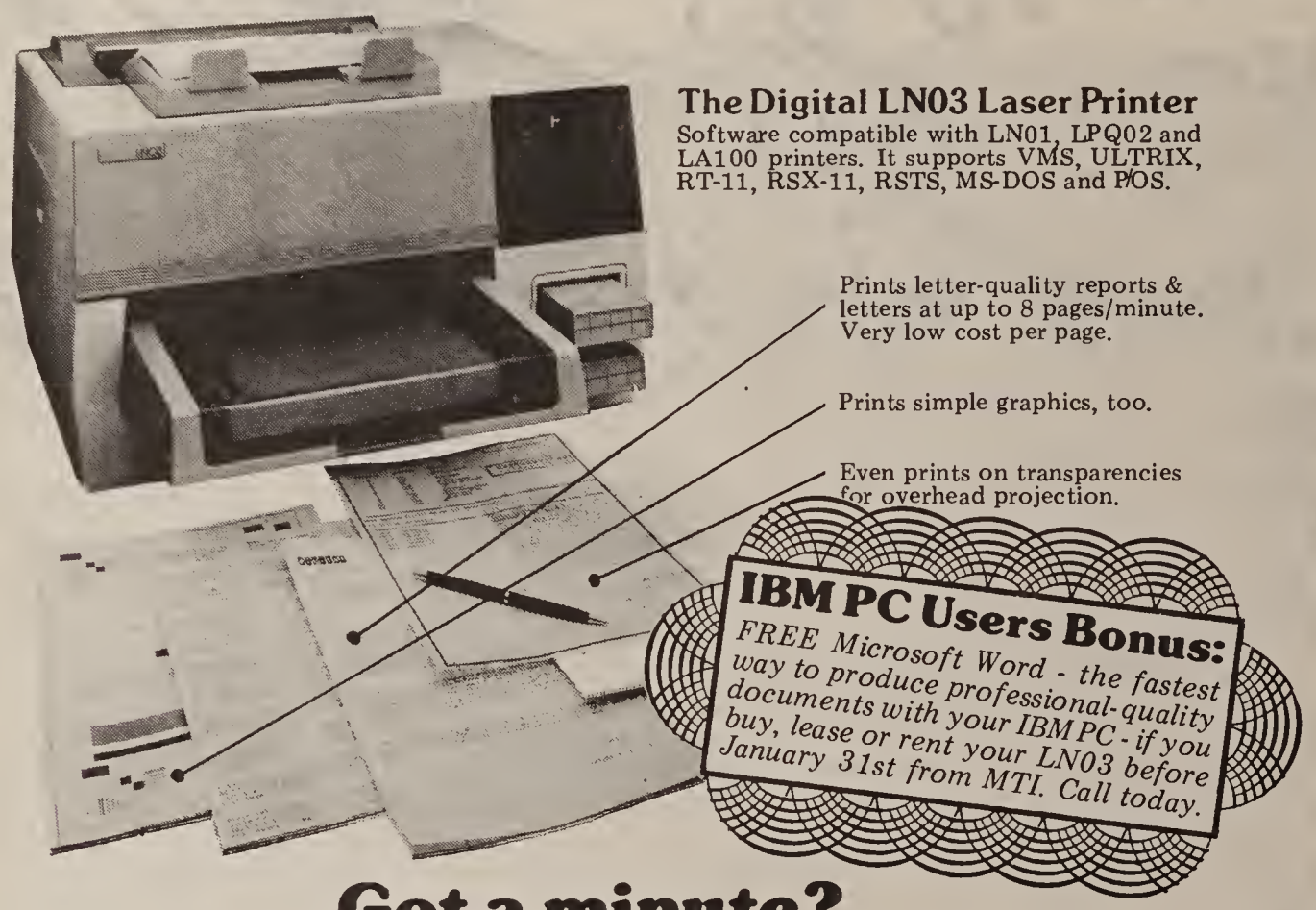
■ **Supercomputers.** Demand for supercomputers should moderate as users wait for the introduction of faster, more powerful systems. U.S. manufacturers will increase deliveries 24% above the 1985 level to roughly $560 million.

■ **Software.** Worldwide revenues of the U.S. software industry should grow about 25% in 1986, according to the forecast. This is slightly above the 23% growth rate registered in 1985, but it is still well below the compound annual growth rate of 51% a year between 1976 and 1983.

■ **Services.** In the wide-ranging information services industry, computer services such as remote data processing and software development will grow moderately in 1986, at a rate of 10% to 15% to about $16.5 billion, while electronic data base services are expected to grow 18% to $2.2 billion.

■ **Semiconductors.** The semiconductor industry will resume its growth in 1986, although by historical standards the recovery will be sluggish. "Product shipments will increase by only 9.7% in nominal terms, an unimpressive outlook given the depressed level of activity in 1985," the report concluded.

■ **Communications.** The report predicted a good year for the communications equipment industry, with overall growth at about 10% in 1986. The growth will result from the modernization of the telephone companies' networks and from increased sales of customer premises equipment, private branch exchanges, local-area networks and other communications equipment.



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Bill aims to curb Communist spy activity in Silicon Valley

WASHINGTON, D.C. — U.S. Rep. Ed Zschau (R-Calif.) recently introduced legislation that he said would restrict the access of Communist spies to California's Silicon Valley and other parts of the U.S.

According to Zschau, the bill, H.R. 3910, would make it more difficult for Soviet bloc intelligence agents to obtain U.S. technological secrets. The bill places travel restrictions on Soviet bloc diplomats, trade emissaries and their families.

Zschau said the bill would place the same travel restrictions on diplomats from Soviet satellite countries as those that currently apply to diplomats from the Soviet Union itself. The bill listed the Soviet bloc countries as East Germany, Bulgaria, Poland, Hungary, Romania, Czechoslovakia, Mongolia, Cuba and Vietnam.

Diplomats from the Soviet Union are prevented from traveling more than 25 miles from their embassy or mission without the permission of the U.S. Department of State and are prohibited from entering certain areas that are critical to national security, such as the Silicon Valley.

Zschau said restricting the travel of Soviet bloc diplomats in the U.S. is necessary because so many Communist spies operate in the U.S. under diplomatic cover.

SUPERSHORTS

Hitachi America Ltd.'s Computer Sales and Service Division has formed a **Software Sales and Support Department**. The department will market scientific and design software for the IBM Personal Computer and Hitachi's full line of computers. Hitachi America is headquartered in Tarrytown, N.Y.

■

Analogic Corp. has acquired 99% of **Computer Design and Applications, Inc.** of Waltham, Mass. Analogic will account for the acquisition as a purchase, and Computer Design and Applications will operate as a 99%-owned subsidiary of Analogic.

■

LISP Machine, Inc. and the **Process Management Division** of **Honeywell, Inc.** announced that the two companies will cooperate in bringing artificial intelligence technology to the process control market. As part of the joint effort, the two companies will work together to interface PICON, LISP Machine's on-line expert system, to the TDC 3000, Honeywell's control system.

■

Dun & Bradstreet Corp.'s Software and Services Group announced the merging of **Dunsplus** into **D&B Computing Services Co.** This action was taken in order to combine the micro expertise of the Dunsplus staff with the micro and mainframe expertise of the D&B Computing Services staff.

■

ITT Information Systems and **Computerland Corp.** announced a renewal of their vendor/franchisor relationship. Effective immediately, all Computerland dealers can order and receive ITT Xtra and Xtra XP personal business computer products directly from Computerland.

■

Alpha Microsystems, Inc. announced the expansion of its national field engineering organization, **Alphaserv**.

■

Seagate Technology, Inc. announced that it will supply 40M-byte Winchester disk drives to **Hewlett-Packard Co.** Initial use of the ST40451, in combination with HP's own custom controller, will be in the recently announced Vectra PC.

■

The **Electronics Marketing Group** of **Wyle Laboratories, Inc.** has signed a franchise agreement with the **Storage Products Division** of **Fujitsu America, Inc.** to distribute Winchester and floppy disk drives in Wyle Laboratories' 14 locations in the U.S.

Fujitsu America, Inc.'s Storage Products Division announced Fujitsu's affiliate, **Copal Company of Japan**, has signed a technology licensing agreement with **Tandon Corp.**

■

Synercom Technology, Inc. has finalized a distributorship agreement with **Mighty Exim Corp.** of Taipei, Taiwan, giving Mighty Exim exclusive rights to distribute Synercom's mapping information management software and workstations in Taiwan.

■

Quadram Corp. and **Microsoft Corp.** have agreed in principle to bundle Microsoft Windows with the recently announced Quadega+ Enhanced Graphics Adaptor board. Microsoft Windows began bundling exclusively with Quadram's Quadega+ this month, and additional bundling arrangements are scheduled for Quadram boards in early 1986.

■

U.S. Telecom and **GTE Sprint Communications Corp.** announced that a definitive agreement has been signed between the two companies. U.S. Telecom will provide capacity along 2,550 route miles of its network while GTE will provide 763 route miles of capacity to U.S. Telecom.

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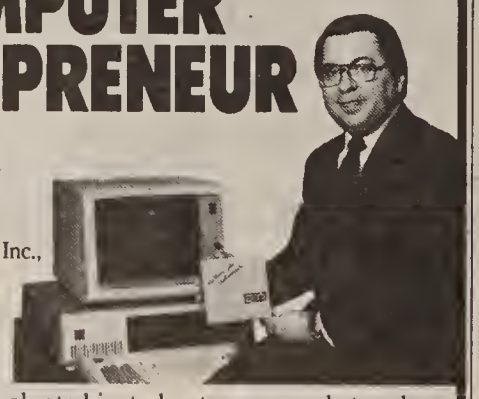

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Louisiana sales law can snag unwary national distributors

OUTSIDE LINES
L.J. Kutten

National distributors of computer hardware or software selling their products in Louisiana must be cognizant that the normal law of sales prevalent throughout the U.S. does not apply there. This exists because Louisiana is the only U.S. jurisdiction that has not adopted Article Two of the Uniform Commercial Code that codifies the law of sales.

Article Two grew out of the English law of merchants. Its purpose is to provide a uniform set of laws dealing with sales, relationships between merchants, creation and disclaimers of warranties and the like, so a person from one state doing business with a person in another state would have a general grasp of what duties and liabilities were required of the other party.

The reason Louisiana has not adopted Article Two is that its law evolved from the French Civil Code. When it became part of the Union, it retained that heritage. While many aspects of Louisiana law are similar to the common law, the law of sales is not one of them.

The main difference facing the distributor is a concept known as "rehibitation." Under Louisiana law, "rehibitation is the avoidance of a sale on account of some vice or defect in the thing sold, which renders it either absolutely useless, or its use is so inconvenient and imperfect, that it must be supposed that the buyer would not have purchased it, had he known of the vice." That is, the product has some defect, which, had it been known to the buyer before purchase, would have caused the buyer to forego the purchase.

There is no objective standard for something to be rehibitory. It is a subjective standard that depends on the needs and desires of each individual purchaser. What is an unimportant and a nonrehibitory defect to one person may be a major and rehibitory defect to another.

It is possible to draft a sales contract whereby a purchaser waives a possible rehibitory defect. Under Louisiana case law, the waiver must meet three criteria:

- It must be clear and unambiguous.
- It must be contained in the sales document.
- It must be brought to the purchaser's attention.

An analysis of cases shows that Louisiana courts are very stringent in applying these criteria. Between 1973 and 1985, there were only four reported cases where the waiver was found to be effective. In those cases, the document containing the waiver was signed by the buyer, and in two of them, signature was made after a lawyer had reviewed the contract.

Furthermore, Louisiana courts are very insistent that there be actual proof that the notice of waiver of warranty was given; it cannot be implied by the mere signing of a contract or other document. Given this requirement, it is very doubtful that warranty disclaimers currently used in most computer products are valid in Louisiana.

There is no doubt that rehibitation can be a powerful consumer protection device. According to the only Louisiana case discussing software, Land and Marine Services, Inc. v. Diablo Data Systems, the buyer does not have to prove the existence of a particular defect. Rather, all that must be shown is that the software failed under normal use to do what it was supposed to do, and the burden of proof then shifts to the seller or developer to prove that the software is not rehibitory.

If a developer or marketer refuses to take back a rehibitory product, the buyer is entitled to damages. These include refund of the purchase price, reimbursement of reasonable expenses incurred in preserving the object and attorney fees.

Kutten is a member of the Missouri and Illinois bars and author of The Computer Buyer's Protection Guide, *published by Prentice Hall, Inc.*

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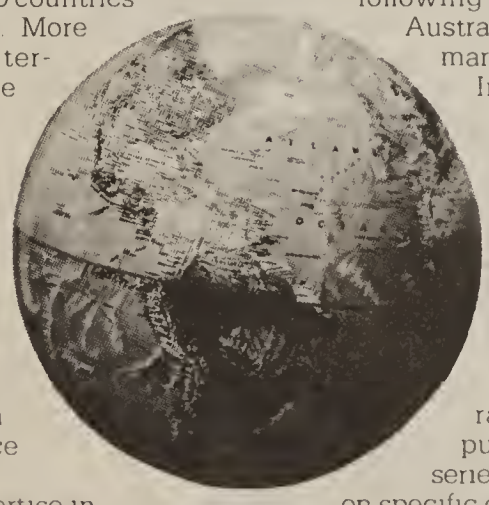

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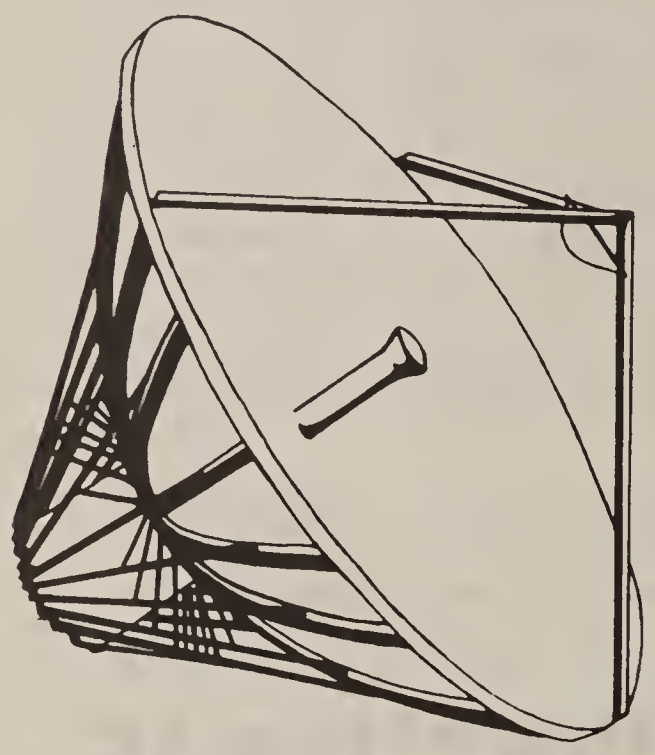

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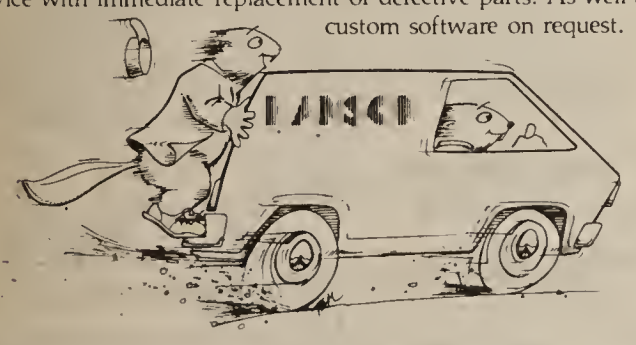

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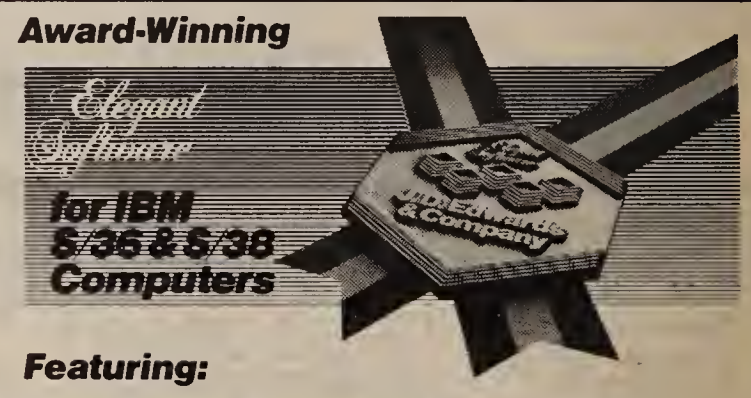

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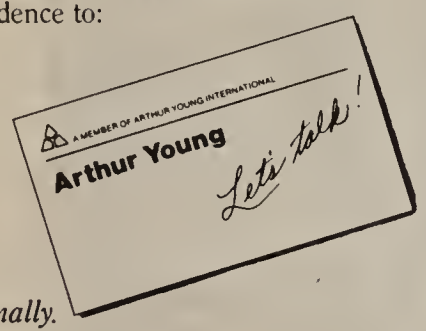

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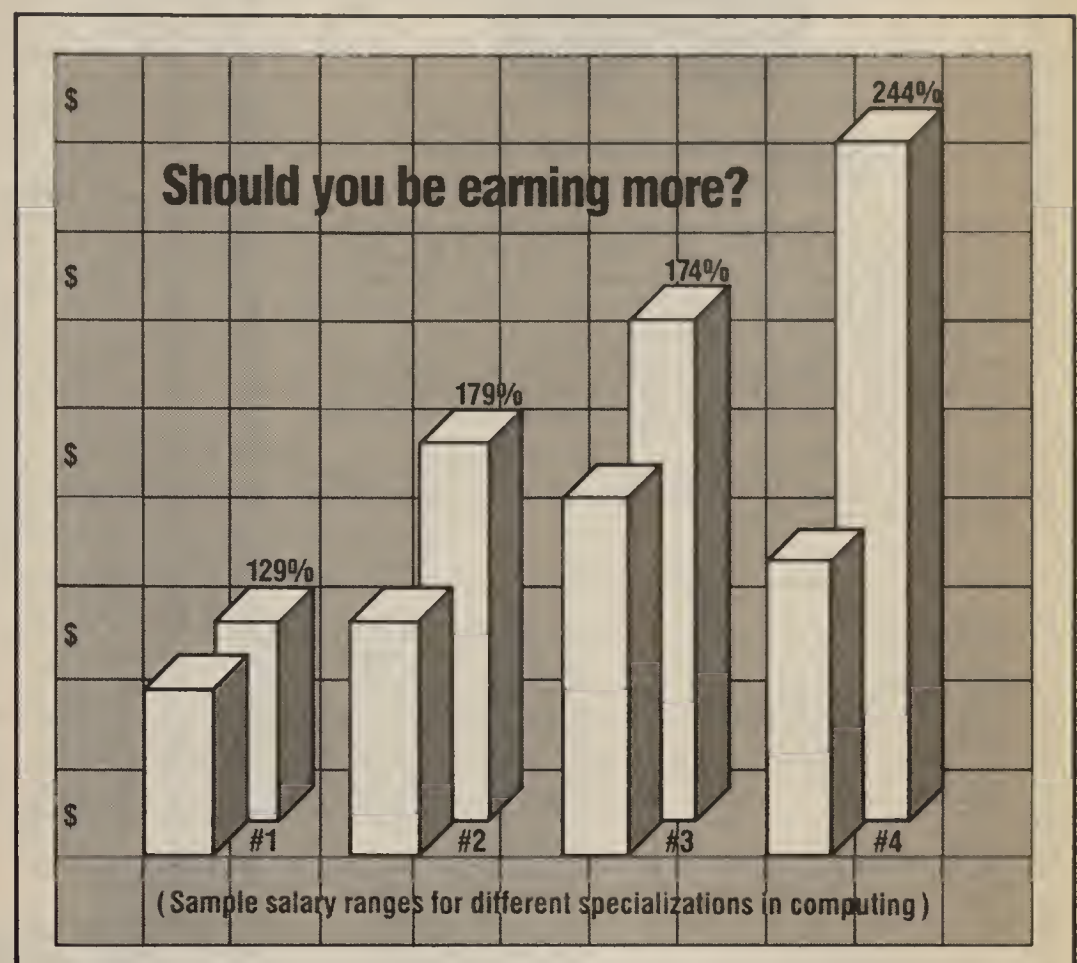

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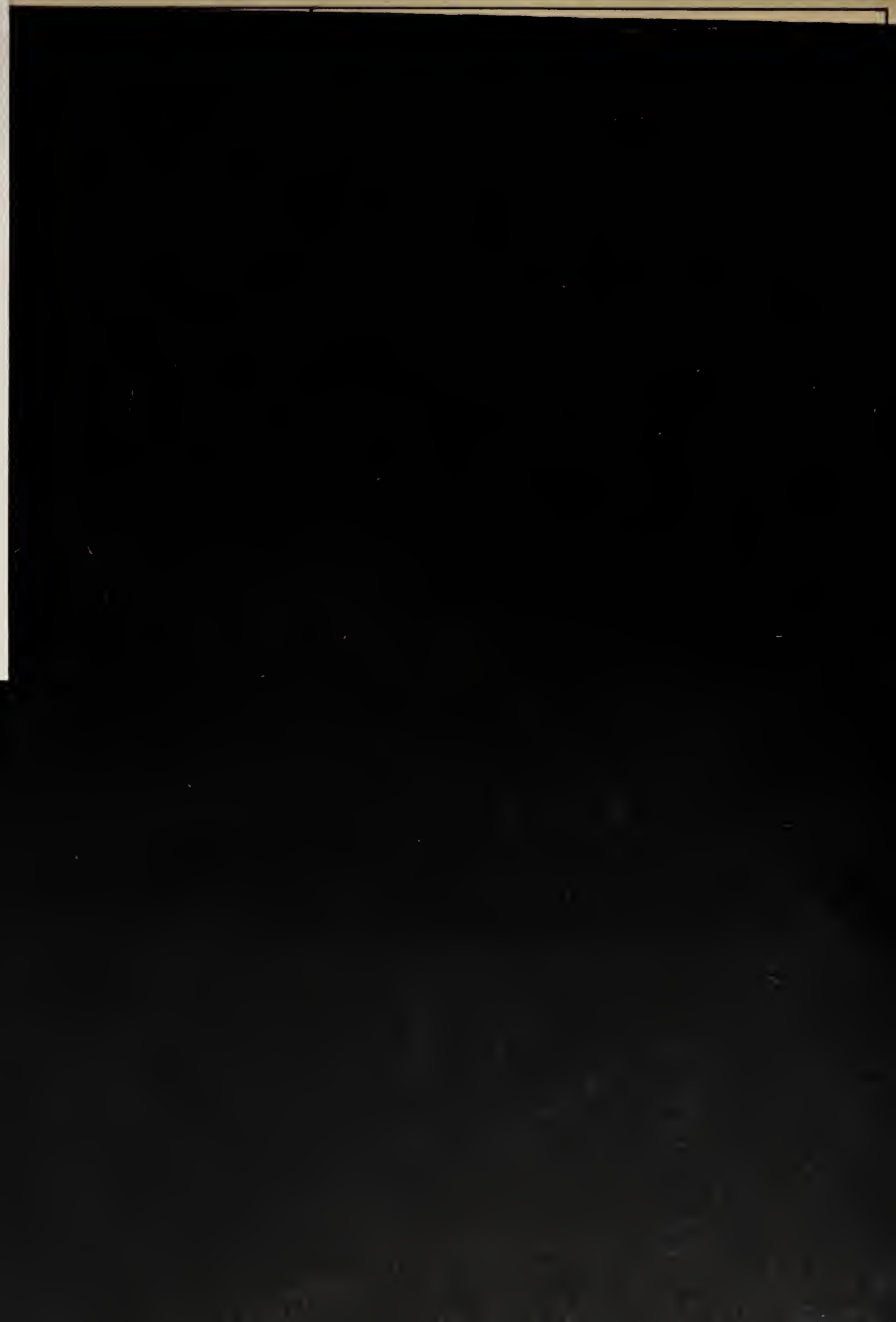

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Please send resume with salary history no later than January 30, 1986 to:

Integrated Information Systems
Manager Technical Systems
P.O. Box 805
San Diego, CA 92112

POSITION ANNOUNCEMENTS

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Norris retires from CDC

From page 134

built such a big company has to step down at such a difficult moment," said mainframe market analyst David Moschella of International Data Corp., in Framingham, Mass.

Many feel that Norris' passing the torch will not change the direction of the company but will spur CDC's movement away from many of its non-computer-related diversifications. "CDC's actions are very constrained by cash flow considerations now, rather than the strategic direction of the CEO," Blauer said.

The former vice-president and general manager of Sperry-Rand Corp.'s Univac division, Norris left to found CDC in 1957. In addition to a first-rate technical background, Norris possessed the corporate philosophy of industry as an instrument for social change. That belief led CDC into businesses ranging from experimental housing to the controversial computer-based education system known as Plato. Detractors felt such projects diverted management's attention away from CDC's lifeblood businesses of systems, peripherals and data processing services, but Norris always stuck to his guns.

"These programs are the future of the company," Norris said in a *Computerworld* interview last year. "It has been a difficult strategy, but it's going to pay off handsomely."

Others have blamed CDC's recent financial woes on its failure to grasp fundamental trends in computing. CDC was alone among the BUNCH companies in not entering the end-user office market, the rise of which has cut into remote time-sharing services such as CDC's. And CDC's building of a large peripherals business through acquisitions was a stroke of genius to compete against IBM in the 1960s, but overcapacity and cut-rate offshore products have since decimated the storage market.

Although fundamental changes in the near term are not likely at CDC after Norris' departure, economic realities will force the company into continued retrenchment from the expansive, acquisitive giant that Norris built. "Initially, his retirement will change the image more than anything," Moschella said. "It will become easier to make necessary changes that he has resisted. Up to now, who was going to go against the chairman? But this is kind of a milestone. There aren't many who have been around longer than Norris."

STC exits strong optical mart

By Maura McEnaney

Storage Technology Corp.'s (STC) recent exodus from the optical disk market by no means sounds the death knell for optical disk technology, analysts said.

"It absolutely is not a reference to any lack of a marketplace for optical memory products," said Les Cowan of "Optical Memory News," published by Rothschild Consultants in San Francisco.

The vitality of the optical memory market was perhaps best illustrated recently at Comdex/Fall '85, where more than 50 firms displayed optical memory products, many of which accompanied displays of computer systems. "This is not just a technology in the lab anymore, it's technology represented by products on the market being used by real applications in real systems," Cowan said.

Financial problems were the driving factor behind Louisville, Colo.-based STC's recent decision to drop production plans for a 14-in. optical disk drive, despite a four-year, $100 million investment. The product of

See **STC** page 133

INDUSTRY NOTES

Strong quarter expected to put MSA in the black

A traditionally strong fourth quarter at **Management Science America, Inc.** (MSA) will return MSA to **profitability for the year,** its top executives said last week. MSA lost $3.2 million on $94 million in sales in the first nine months of 1985, but Chairman and Chief Executive Officer **John P. Imlay Jr.** estimated a 55 cent/share fourth-quarter profit, or enough for MSA to finish in the black for the year, according to Dow Jones News Services.

Full-year revenue will be more than $150 million, slightly above $141.8 million in 1984. **MSA** earned $13.5 million from **continuing operations** last year but lost all but $243,000 of it on **write-downs** from its discontinued **Peachtree** microcomputer software business.

■

Software Publishing Corp. cofounder, president and **CEO Fred Gibbons** is undergoing therapy at **Stanford Medical Center** in **Palo Alto, Calif.**, after suffering an apparent stroke while on a ski trip at **Squaw Valley** over the holidays.

A spokeswoman for the **Mountain View, Calif.**, company reported that Gibbons, 36, has lost muscle control in much of the left side of his body but is mentally alert and already undergoing **physical therapy**. A friend said the stroke was caused by the bursting of undetected weak blood vessels that had been present since birth.

While Gibbons will remain involved with corporate strategy, company **cofounder and Vice-President Janelle Bedke** will handle **day-to-day management** of the company. Bedke is expected to remain in charge for at least one month.

■

Playing the stock market last week was **Wang Laboratories, Inc.**, which announced a $185.4 million public offering of its **Class B common stock.** Vice-Chairman and Chief Financial Officer **Harry H. S. Chou** said **proceeds** from the sale are not required to meet current **cash needs** but will be used to reduce its **debt/capitalization ratio** to "a more desirable level."

■

The **New York Stock Exchange** suspended trading in **Applied Data Research, Inc.** last week after **Ameritech** announced that approximately 95% of ADR's stock had been tendered under Ameritech's $32/share **tender offer,** announced in November 1985. The exchange normally delists companies if less than 600,000 of their common shares are held publicly. The acquisition makes ADR a wholly owned subsidiary of Ameritech.

■

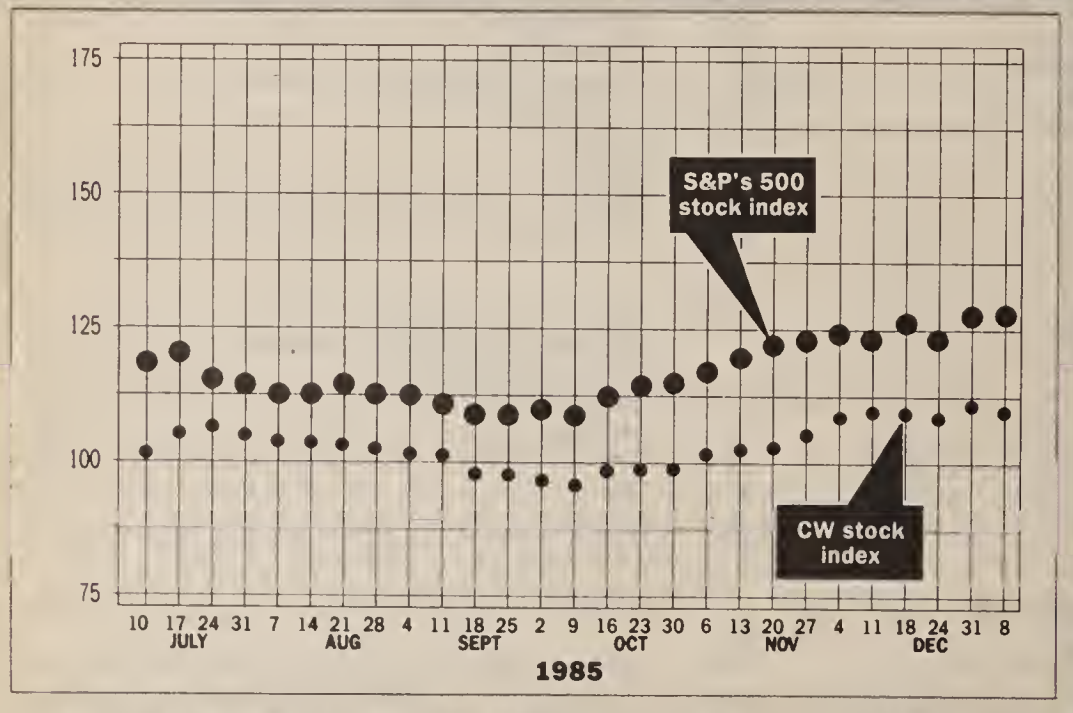
Richard Streller resigned as chairman and CEO of **Hogan Systems, Inc.** of Dallas, with President **George L. McTavish** taking over the chief executive's post. Former Chairman **Gregor Peterson** returned to his old position. Streller joined the financial software house in 1977 and became CEO in 1981.

■

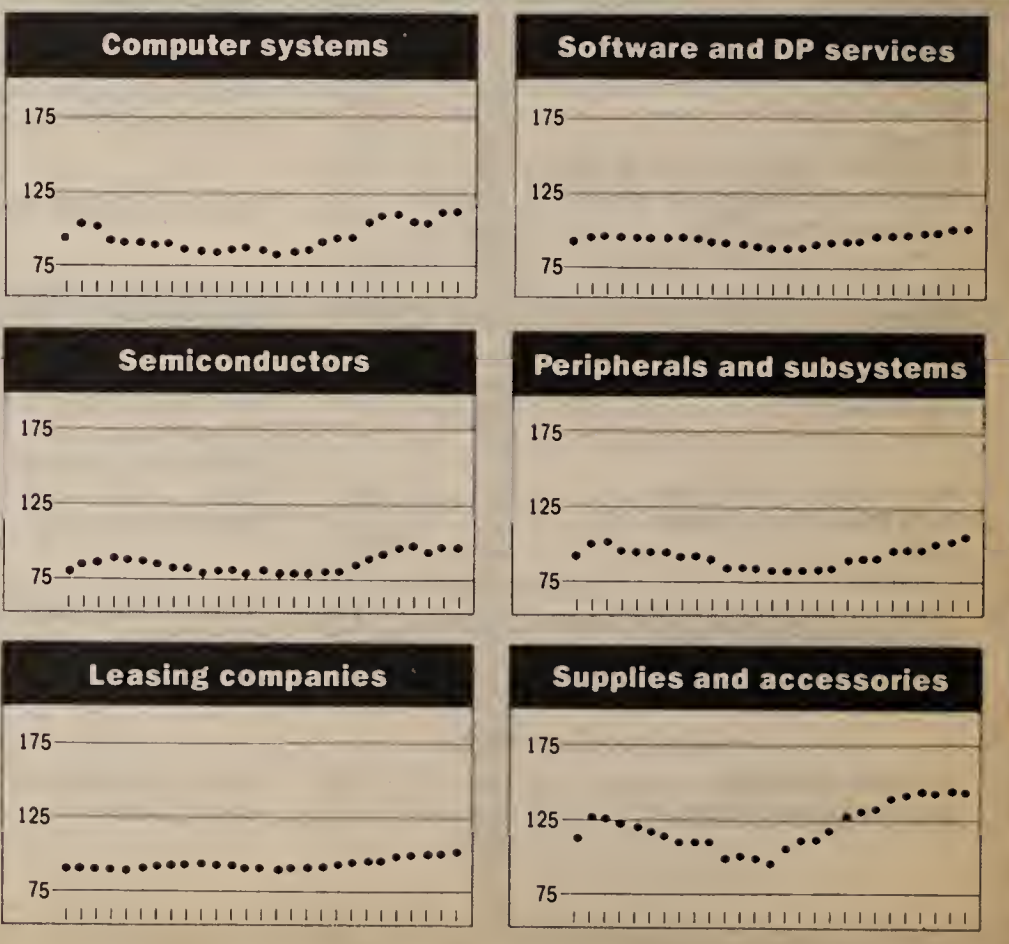
Commodore International Ltd. announced the closing of a **custom semiconductor plant** in Costa Mesa, Calif., and a **computer assembly plant** in **Corby, England,** resulting in a total **layoff of 450 personnel.**

MITCHELL J. HAYES

Computerworld stock trading index



All indexes reflect a historical base of 100 on Dec. 31, 1984, and trace stock market performance in relation to that base. The CW stock index represents the unweighted average performance of the six categories of computer industry stocks.



STC exits strong mart

From page 132

that effort, demonstrated in STC laboratories, was capable of storing 4G bytes per disk side and transferring information up to 3M byte/sec., a spokesman for the company said. Had it made it to market, the STC drive would have been the fastest and largest optical disk product available, analysts said.

STC, which filed for protection under Chapter 11 of the Federal Bankruptcy Code in October 1984, has been working on a reorganization plan to trim expenses. Robert Costain, STC's vice-president for strategic planning, said the firm is approaching final negotiations with its credit committee. STC cannot afford an estimated $80 million needed to bring the product into production by 1988, Costain said.

Optical disk technology will see some significant market inroads this year, particularly at the low end with compact disk storage units. Worldwide shipments of compact disk read-only memory drives will reach 40,000 this year and 353,000 in 1988, according to "Disk/Trend," a storage industry newsletter. Most of those installations will be used in conjunction with micros.

Year-end tallies: Don't look for any surprises

ACTIVE ISSUES
Kathy Porteus

By most accounts, financial results for the December 1985 quarter are nothing to write home about.

Michael R. Weisberg, director of technology research at Prudential-Bache Securities, Inc., says he believes the December quarter results "will be in line with expectations in the computer sector." Weisberg added, "I don't think you're going to see major surprises in either direction, " he said.

Undoubtedly, most attention focuses on IBM's fourth-quarter earnings. Despite three down quarters, IBM has insisted that net income for fiscal 1985 would show slight improvement over fiscal 1984's net of $6.58 billion.

Porteus is president of Strand Research Associates, a Centerville, Mass.-based company that provides customized research services for financial and high-tech firms.

To match last year's performance, IBM will need to post December quarter earnings of $4.46 per share, which would represent a 25% increase in net income over 1984's fourth quarter.

"Clearly, IBM is pulling out all the stops to show that up year," says Steve Milunovich, a technology analyst with First Boston Corp. Nevertheless, Milunovich estimates that IBM will fall a little short of the mark, earning $10.65 per share for the year vs. $10.77 per share in fiscal 1984.

A number of analysts share Milunovich's view that IBM's fourth-quarter results will be somewhat disappointing. According to Zachs Investment Research, Inc., a Chicago-based consulting firm that tracks Wall Street estimates, the average earnings estimate for IBM's fourth quarter is $4.38 a share. A slight disappointment in earnings is not expected to affect IBM's stock price significantly.

According to Milunovich, there should be few surprises in the December quarter results for BUNCH companies. He estimates Burroughs Corp. will show an up quarter with $2.17 per share against $2.08 per share in last year's fourth quarter.

"Honeywell, Inc. is stretching to get back to a flat year," Milunovich says, "but I don't think they will do it." Milunovich estimates Honeywell will earn $2.62 per share in the December quarter.

"If any company gives us a modest up side surprise, it will be Digital Equipment Corp.," says Barry Bosak, vice-president with Eberstadt Fleming, Inc. In addition to DEC, Fran Saldutti, vice-president of Investment Strategies at Gartner Securites Corp., says he believes Prime Computer, Inc. and Intergraph Corp. may report better-than-expected earnings.

As with other sectors of the computer industry, fourth-quarter results for semiconductor companies should yield few surprises. Paul Johnson of L. F. Rothschild, Unterberg, Towbin estimates that, barring any unexpected write-offs, Advanced Micro Devices, Inc. will lose 45 to 50 cents per share, and Motorola, Inc. will lose 5 to 10 cents per share in the December quarter. Johnson says he expects Intel Corp. to report a fourth-quarter loss of 15 cents per share for a break-even year.

According to Rick Sherlund, senior securities analyst with Goldman, Sachs & Co., software business in the December quarter should have been seasonally stronger than the previous quarter, "but on a year-over-year basis, there will not likely be any meaningful uptick."

Sherlund estimates that Lotus Development Corp. will probably report fourth-quarter earnings between 70 and 80 cents a share vs. 73 cents a share in the fourth quarter of 1984. Software Publishing Corp., Sherlund estimates, will post a significant down quarter — in the 20 to 30 cents per share range — owing to lackluster seasonal sales.

"The chances of an up side surprise among software companies are probably greatest with Cullinet," Sherlund observes. Cullinet Software, Inc.'s quarter ends Jan. 31.

"Investors are looking for a reason to be encouraged about Cullinet," Sherlund adds, "so Cullinet's stock would view any unexpected earnings improvement very positively."

Computerworld stock trading summary

CLOSING PRICES WEDNESDAY, JANUARY 8, 1986

EXCH		52-WEEK RANGE (1)	CLOSE JAN 8 1986	WEEK NET CHNGE	WEEK PCT CHNGE
	CO	5- 9	6 1/8	- 1/6	-2.0
O	ALPHA MICROSYSTEMS	5- 6	6 1/8	- 1/8	-2.0
O	ALTOS COMPUTER SYST	6- 14	13 5/8	+ 7/6	+2.8
A	AMDAHL CORP	10- 18	13 7/8	- 3/4	-5.1
O	APPLE COMPUTER INC	14- 31	22 7/8	+ 7/8	+3.6
O	APOLLO COMPUTER	9- 31	13	-1	-7.1
N	AT&T	18- 28	24 3/6	- 5/8	-2.5
N	BURROUGHS CORP	52- 68	62 1/4	-1 1/8	-1.7
O	COMPAQ COMPUTER CP	5- 14	13 1/4	0	0.0
O	COMPUTER AUTOMATION	1- 9	2 7/8	0	0.0
A	COMPUTER CONSOLES	5- 14	7 1/8	- 1/4	-3.3
N	CONTROL DATA CORP	15- 39	21 3/8	+ 5/8	+2.0
O	CONVERGENT TECHNOL	5- 13	12 5/8	+ 3/4	+6.3
O	CPT CORP	5- 8	6 3/4	+ 5/8	+10.2
N	CRAY RESEARCH INC	25- 71	61 3/4	-3 3/4	-5.7
O	DAISY SYSTEMS CORP	21- 38	27 1/2	-2	-6.7
N	DATA GENERAL CORP	31- 76	42 7/8	-2 1/2	-5.5
N	DATAPOINT CORP	5- 22	5 3/8	- 1/8	+2.3
N	DIGITAL EQUIPMENT	85-137	133 1/2	+1	+0.7
A	EECO INC	13- 16	14 3/4	- 1/8	-0.8
N	ELECTRONIC ASSOC.	3- 6	4 5/8	+ 3/8	+8.8
N	FLOATING POINT SYST	18- 37	33 1/2	-2	-5.6
N	FOXBORO	22- 31	26 5/8	+ 5/8	+2.4
O	GOULD INC	20- 38	29 7/8	- 3/4	-2.4
N	HARRIS CORP	22- 35	26 3/4	- 1/2	-1.8
N	HEWLETT-PACKARD CO	29- 39	37	+ 1/4	+0.6
N	HONEYWELL INC	54- 87	72 1/2	-1 5/8	-2.1
N	IBM	117-156	148 7/8	-6 5/8	-4.2
O	IPL SYSTEMS INC	1- 4	1 5/8	+ 1/2	+44.4
N	ITT CORP	28- 38	37 3/4	- 1/4	-0.6
N	M/A-COM INC	13- 24	13 7/8	-1 1/8	-7.5
N	MANAGEMENT ASSIST	2- 28	3 1/4	0	0.0
N	MATSUSHITA ELEC(ADR)	49- 68	62 1/8	-2 1/4	-3.4
O	MENTOR GRAPHICS	13- 30	17 1/8	-2 3/8	-12.1
N	MODULAR COMPUTER SYS	6- 9	6 7/8	- 1/8	-1.7
N	MOHAWK DATA SCI	1- 13	2 3/8	- 1/8	-5.0
N	NBI INC	11- 20	12 1/8	- 3/4	-5.8
N	NCR	25- 43	40 1/8	- 1/8	-0.3
N	PERKIN-ELMER	22- 31	30	- 7/8	-2.8
N	PRIME COMPUTER INC	15- 24	22 1/4	+ 5/8	+2.8
N	SPERRY CORP	39- 59	52	-2 1/2	-4.5
O	STRATUS COMPUTER INC	6- 25	22	-1 3/4	-7.3
O	TANDEM COMPUTERS INC	13- 29	20 1/4	-2	-8.9
N	TANDY CORP	24- 42	36 1/2	-1 1/4	-3.0
O	TELEVIDEO SYSTEMS	2- 4	3	0	0.0
O	TELXON CORP	10- 23	22 7/8	- 1/8	-0.5
N	TEXAS INSTRUMENTS	86-132	104	-1 1/2	-1.4
A	ULTIMATE CORP	8- 24	24 1/4	0	0.0
O	VECTOR GRAPHICS INC	0- 1	1 1/8	0	0.0
A	WANG LABS "B"	15- 29	18	-2 1/2	-12.1
A	WANG LABS "C"	15- 29	18 1/8	- 1/2	-2.5
N	XEROX CORP	37- 61	58 3/4	-1	-1.6
	LEA	4- 5	4 1/4	+ 1/4	+6.2
N	COMDISCO INC	10- 29	28 1/4	- 3/8	-1.3
N	CONTINENTAL INFO SYS	5- 15	15	+ 1/4	+1.6
O	FINALCO GROUP INC	4- 5	4 1/4	+ 1/4	+6.2
O	PHOENIX AMERICAN INC	2- 4	3 3/8	+ 3/8	+12.5
O	SELECTERM INC	7- 12	7 1/4	- 3/4	-9.3
N	U.S. LEASING	32- 43	40 3/8	- 3/6	-0.9
	G	18- 28	25 3/8	-1	-3.7
N	ADVANCED MICRO DEV	22- 38	26 7/8	-2 1/8	-7.3
O	ADV D SEMICONDUCTOR	7- 23	9	0	0.0
N	ANALOG DEVICES INC	18- 28	25 3/8	-1	-3.7
O	ANALOGIC CORP	11- 16	14 3/4	- 1/4	-1.6
N	APPLIED MAGNETICS CP	9- 17	16 1/2	+1 5/8	+10.9
O	AVANTEK	18- 26	20	+ 7/8	+4.5
O	HADCO CORP	3- 7	6 1/8	0	0.0
O	INTEL CORP	21- 33	26 3/4	-2 1/2	-8.5
O	MICRO MASK INC	6- 12	6 3/4	+ 1/4	+3.8
N	MOTOROLA INC	28- 41	36 1/2	-2 3/8	-6.1
N	NAT L SEMICONDUCTOR	10- 15	12 5/8	+ 1/8	+1.0
N	TERADYNE	17- 33	22 1/2	- 5/8	-2.7

SOFTWARE & EDP SERVICES

EXCH		52-WEEK RANGE (1)	CLOSE JAN 8 1986	WEEK NET CHNGE	WEEK PCT CHNGE
O	ADVANCED COMP TECH	2- 4	4 1/8	+ 1/4	+6.4
N	ADVANCED SYSTEMS INC	9- 18	17 1/4	- 1/2	-2.8
N	AGS COMPUTERS INC	10- 24	23 5/8	+ 1/2	+2.1
O	AMERICAN SOFTWARE	9- 15	13 1/2	+1	+8.0
N	ANACOMP INC	2- 4	3 5/8	+ 1/4	+7.4
O	ANALYSTS INTL CORP	5- 11	7 3/4	0	0.0
N	APPLIED DATA RES	16- 38	31 7/8	- 1/8	-0.3
O	ASHTON TATE	6- 20	19 3/4	+1 3/8	+7.4
O	ASK COMPUTER SYSTEMS	7- 25	13	- 1/8	-0.9
B	ASTRODYNE COMP IND	1- 3	2	0	0.0
N	AUTOMATIC DATA PROC	35- 60	58 7/8	- 1/8	-0.2
O	COMPUTER ASSOC INT'L	18- 35	34 1/4	- 3/4	-2.1
O	COMPUTER HORIZONS	5- 11	11 1/8	0	0.0
O	COMPUTER NETWORK	6- 8	5 1/2	0	0.0
N	COMPUTER SCIENCES	13- 34	31 7/8	-1 5/8	-4.8
O	COMPUTER TASK GROUP	10- 24	21 1/4	- 5/8	-2.8
O	COMPUTER USAGE	1- 3	1 5/8	0	0.0
O	COMPUTONE SYSTEMS	4- 11	5	+ 3/8	+8.1
O	COMSERV CORP	1- 6	3 1/2	0	0.0
O	COMSHARE	7- 12	10 7/8	+ 3/8	+3.5
N	CULLINET SOFTWARE	13- 33	18	-1	-5.2
O	CYCARE SYSTEMS INC	19- 27	21 1/4	0	0.0
O	HOOAN SYSTEM INC	4- 12	7 1/4	+ 1/4	+3.5
N	GENERAL ELECTRIC CO	56- 74	70 3/4	-2	-2.7
N	GENL MOTORS E (EDS)	20- 47	37 7/8	-3	-7.3
N	GTE CORP	38- 47	46 3/4	+ 3/4	+1.6
O	INFORMATION SCIENCE	1- 5	1 1/2	- 3/8	-20.0
O	INFOTRON SYSTEMS CP	13- 24	17 1/2	- 3/4	-4.1
O	KEANE ASSOCIATES	10- 20	15	0	0.0
N	LOGICON	25- 43	38 3/4	-1 1/4	-3.0
O	LOTUS DEVELOPMENT CP	15- 34	23 3/4	-1 1/4	-5.0
O	MCI COMMUNICATIONS	7- 11	10 7/8	- 3/8	-3.3
O	MNGT SCI AMER INC	7- 16	11 1/2	+ 1/2	+4.5
O	MATHEMATICAL APP CRP	1- 8	2	0	0.0
O	MICOM SYSTEMS INC	12- 35	20	-2 1/4	-10.1
O	MICROPRO INT'L CP	2- 4	2 5/8	+ 1/8	+5.0
O	NATIONAL DATA CORP	8- 18	17 3/4	- 1/2	-2.7
O	ON-LINE SOFTWARE INT	4- 11	11	0	0.0
O	PANSOPHIC SYSTEMS	14- 27	24	- 1/2	-2.0
N	PLANNING RESEARCH	11- 19	15 7/8	- 1/4	-1.5
O	POLICY MGMT SYSTS CP	17- 35	23	0	0.0
O	PROGRAMMING & SYS	4- 6	8	0	0.0
O	REYNOLDS & REYNOLD	31- 57	54 1/4	-3	-5.2
O	SEI CORP	13- 25	25	+1 1/2	+6.3
O	SHARED MEDICAL SYST	26- 37	34 5/8	- 5/8	-1.7
O	SCIENTIFIC COMPUTERS	5- 8	5 1/2	0	0.0
O	SOFTWARE AG	12- 22	17 1/4	+ 1/8	+0.7
N	URS CORP	10- 14	12 5/8	- 1/2	-3.8
N	UCCEL	11- 17	16 5/8	- 3/4	-4.3
O	VM SOFTWARE	17- 24	20 3/4	-2 3/4	-11.7

PERIPHERALS & SUBSYSTEMS

EXCH		52-WEEK RANGE (1)	CLOSE JAN 8 1986	WEEK NET CHNGE	WEEK PCT CHNGE
P	AM INTERNATIONAL	3- 6	5 7/8	- 1/8	-2.0
A	ANDERSON JACOBSON	2- 5	2 1/8	- 3/8	-15.0
O	AST RESEARCH INC	7- 33	29 1/4	-1 1/2	-4.8
O	AUTO-TROL TECHNOLOGY	3- 13	5 3/8	+ 5/8	+13.1
O	AVANT-GARDE COMPUTNG	3- 21	5 3/4	0	0.0
O	BANCTEC INC	6- 12	8 1/4	+ 7/8	+11.8
O	BEEHIVE INT'L	1- 2	1 1/8	0	0.0
N	BOLT-BERANEK & NEW	20- 37	35 3/8	0	0.0
O	CAMBEX CORP	1- 3	7/8	0	0.0
N	CENTRONICS DATA COMP	3- 11	4 5/8	- 3/8	-7.5
A	CETEC CORP	6- 9	7 1/4	+ 1/4	+3.5
A	COGNITRONICS	4- 7	4 1/2	+ 3/8	+6.0

EXCH		52-WEEK RANGE (1)	CLOSE JAN 8 1986	WEEK NET CHNGE	WEEK PCT CHNGE
N	COMPUGRAPHIC CORP	24- 36	27	- 3/8	-1.3
O	COMPUTER TRANSCEIVER	1- 1	1/2	- 1/16	-8.9
N	COMPUTERVISION CORP	9- 44	12	- 5/8	-4.9
N	CONRAC CORP	12- 16	15 5/8	- 3/8	-2.3
A	DATAPRODUCTS CORP	11- 20	15 7/8	- 1/2	-3.0
A	DATARAM CORP	4- 9	8 3/8	- 1/2	-5.8
O	DATA SWITCH CORP	4- 9	6 1/4	0	0.0
O	DATUM INC	5- 9	5 3/8	- 1/8	-2.2
O	DECISION DATA COMPUT	10- 20	12 5/8	- 5/8	-4.7
O	ENDATA, INC	2- 8	4 1/4	0	0.0
O	EVANS & SUTHERLAND	12- 21	18	- 1/4	-1.3
O	GANDALF TECHNOLOGIES	5- 13	6 7/8	- 1/2	-8.7
N	GEN'L DATA COMM IND	8- 21	11 1/8	- 5/8	-5.3
N	HAZELTINE CORP	20- 30	25 1/2	+2 1/2	+10.8
O	ICOT CORP	3- 8	8 1/4	+ 1/4	+3.1
O	INFORMATION INTL INC	10- 17	13 1/2	0	0.0
O	INTECOM INC	4- 11	5 1/4	+ 1/4	+5.0
A	LUNDY ELECTRONICS	10- 15	12 7/8	- 5/8	-4.6
O	MEGADATA CORP	3- 8	4 3/4	+1 1/8	+31.0
A	MSI DATA CORP	7- 13	11 1/2	+1 3/8	+13.5
N	NASHUA CORP	24- 31	31 1/8	- 1/4	-0.7
O	NETWORK SYSTEMS CORP	15- 27	14 5/8	-5 5/8	-27.7
N	NO AMERICAN PHILIPS	32- 45	37 1/4	0	0.0
N	NORTHERN TELECOM LTD	31- 41	32 1/4	-2 3/4	-7.8
O	OMEX	1- 3	1/2	0	0.0
N	PARADYNE CORP	7- 18	7 1/8	+ 1/8	+1.7
A	PENCIL CORP	7- 14	8 1/2	+1 3/8	+19.2
N	PLESSEY CO (ADR)	19- 28	25 1/2	- 3/4	-2.8
O	PRINTRONIX INC	9- 18	13	0	0.0
O	QMS INC	6- 18	9 5/8	+ 1/2	+5.4
O	RAMTEK CORP	2- 7	3 1/4	- 1/8	-3.7
N	RECOGNITION EQUIP	8- 17	15 1/4	+1 3/4	+12.8
N	SANDERS ASSOCIATES	30- 44	35	+ 5/8	+1.8
O	SCAN-TRON CORP	6- 16	15 3/4	+ 1/2	+3.2
N	SCIENTIFIC ATLANTA	10- 15	11 3/4	+ 1/8	+1.0
L	SEAGATE TECHNOLOGY	5- 6	7 5/8	+ 3/8	+5.1
N	STORAGE TECHNOLOGY	1- 4	3 1/4	+1 1/2	+85.7
O	SYKES DATATRONICS	0- 2	1/8	0	0.0
N	T BAR INC	5- 8	5 3/4	+ 5/8	+12.1
A	TAB PRODUCTS CO	14- 21	17 7/8	0	0.0
O	TANDON CORP	3- 8	4 5/8	- 1/4	-5.1
A	TEC INC	7- 13	7	- 1/8	-1.7
N	TEKTRONIX INC	47- 88	56 3/8	+ 1/8	+0.2
N	TELEX	34- 80	59 1/2	- 1/8	-0.2
O	TESDATA SYSTEMS CP	0- 3	1 1/4	0	0.0
N	TIMEPLEX INC	15- 23	22	-1 1/8	-4.8
N	TITAN CORP	4 10	8 3/4	+ 3/4	+8.3
O	VISUAL TECHNOLOGY	1- 3	5/8	- 1/8	-16.6
	BURR	21- 35	34 1/2	+ 1/2	+1.4
N	AMERICAN BUS PRODS	21- 35	34 1/2	+ 1/2	+1.4
N	BARRY WRIGHT	17- 26	18 3/8	5/8	3.5
A	DUP EX PRODUCTS INC	13- 22	21 3/8	- 1/4	-1.2
N	ENNIS BUS. FORMS	14- 24	23		0.0
N	3M COMPANY	74 82	80 1/2	1 1/4	1.3
N	MOORE CORP LTD	15- 22	19 3/4	- 1/2	-2.4
A	STANDARD REGISTER	22- 39	38 1/4	+ 3/4	+2.1
N	WALLACE COMP SERVICE	30- 41	41 1/2	+ 7/8	+2.2

EXCH: N=NEW YORK; A=AMERICAN; P=PACIFIC; B=BOSTON;
L=NATIONAL; M=MIDWEST; O=OVER-THE-COUNTER
O-T-C PRICES ARE BID PRICES AS OF 3 P.M. OR LAST B.O
(1) TO NEAREST DOLLAR

Source: Trade Quotes, Inc

COMPUTER INDUSTRY

INSIDE

Paradyne is suspended from all new federal contracts until its pending fraud indictment is resolved/**101**

GTE Telenet and the American Medical Association are in a legal battle over Telenet's alleged sabotage of the AMA's data base/**104**

INSTANT ANALYSIS

"What we're seeing now is the emergence of a handful of world-class players — players who recognize that to survive, the rules of the game are set not by themselves, but by the customers whose problems they must solve."

— Joseph J. Kroger, president and chief operating officer Sperry Corp.

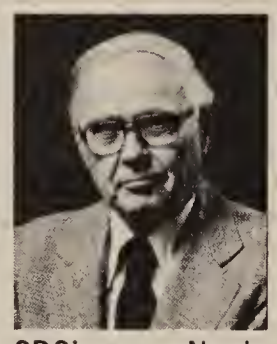
Norris retires from CDC

Price named successor for beleaguered company

By Clinton Wilder

MINNEAPOLIS — An era in mainframe computer history came to an end last Friday when 74-year-old William C. Norris, the venerable and sometimes crusty chairman and chief executive officer of Control Data Corp., announced his retirement from the company he founded 29 years ago.

The CDC board accepted Norris' retirement and named President Robert M. Price, who has run the firm's day-to-day operations since 1980, to succeed him. The promotion appeared to be a vote of confidence in Price, but some analysts believe the board and the company's creditor banks are still considering further changes in top management.



CDC's Norris passes the torch.

"Whether Price's elevation will be permanent or interim remains to be seen," according to Gary Blauer of Dain, Bosworth, Inc., an investment firm based in Minneapolis.

Norris' departure comes at a tumultuous time for CDC, which has been struggling to keep its financial ship afloat in recent months. CDC's core mainframe systems business is expected to lose some $100 million in fiscal 1985 and other divisions are also running in the red. CDC has sold off or scrapped many pieces of its peripherals and financial services businesses and laid off some 9,000 employees.

"It is unfortunate that a guy who has

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ADR exec's success typifies rise of independent software market

By Charles Babcock

PRINCETON, N.J. — When Martin A. Goetz was awarded Patent No. 3,380,029 17 years ago, the headline in *Computerworld* read: "First Patent Is Issued for Software; Full Implications Are Not Yet Known" [CW, June 19, 1968].

Now, two of the implications are known.

His company, Applied Data Research, Inc. (ADR), which entered the software business with $21,000 in capital, is worth $215 million today, according to the tender offer from Ameritech of Chicago [CW, Nov. 25]. And Goetz, who advanced $3,000 to the embryonic ADR, will walk away with $8.3 million when he sells his 260,480 shares of stock.

More than anything else, the Ameritech-ADR deal is a sign of how much the independent software industry has matured in less than two decades and of how Goetz, one of its pioneers and ADR's president, has been able to capitalize on his early role in that industry.

Since the first patent that protected rights to software was issued, an array of third-party software houses has sprung up in the $100+ million revenue class, including Uccel Corp., Management Science America, Inc., Computer Associates International, Inc. and Cullinet Software, Inc.

"He has been a pioneer in the creation of independent software products. . . . I don't think anyone has played a more ac-

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INDUSTRY INSIGHT
Clinton Wilder
and Peggy Watt

Industry mulls omens for '86

It is time again to dust off the crystal ball for a new year, and the question facing would-be computer industry sages is one that few would have dreamed of one year ago. It is simply: "Will the computer slump continue?"

Many will hold their answers until this Friday when Telex machines will clatter with the fourth-quarter and year-end financial results from Armonk, N.Y. Few IBM quarters in recent memory have been watched as closely as this one — and with good reason. Not only have the setbacks of 1985 placed Big Blue's target of 15% annual profit growth in serious doubt, but its first full quarter of Sierra ramp ups will be a strong indication of market response both to that specific box and to new upgrade machines in general.

The feeling is that IBM's numbers will be respectable but no great shakes — and that description will prevail. High-tech stocks may be soaring currently, but they're a half-masted ship riding a Dow Jones tidal wave of a market rally. When the wave crests, they may continue to sail, but slowly.

With capital spending showing no signs of a significant pickup, the demand for new computer hardware that leveled in 1985 will apparently remain sluggish. There will always be exceptions — Digital Equipment Corp.'s Microvax II comes to mind — but the No. 1 market lesson of '85 will still ring true: Technology will not sell itself.

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Report predicts modest growth

Commerce Department sees computer rebound

By Mitch Betts

WASHINGTON, D.C. — The semiconductor and computer industries will be the two fastest growing U.S. manufacturing industries in 1986, according to the U.S. Department of Commerce's latest forecast.

The agency's "1986 U.S. Industrial Outlook" report predicted that sales of computer equipment will increase 16% to $65.8 billion and that sales of semiconductor devices will increase 11% to $19.2 billion in 1986.

For both industries, the predictions indicate a modest recovery from a dismal 1985. Computer industry sales increased a relatively small 8% in 1985, and semiconductor industry sales dropped 15% in 1985, the department estimated.

A year ago, the department predicted that in 1985 computer equipment sales

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Computer industry forecast

Industry	Revenue Growth 1985-1986
Computer equipment	16%
Software	25%
Semiconductors	11%
Communications services	7%
Communications equipment	10%
Fiber-optic systems	20%
Robotics	20%
DP services	10%
Software and professional services	17%
Systems integrators	8%
Electronic data base services	18%

Source: U.S. Department of Commerce

The U.S. Commerce Department predicts that, after software, fiber optics and robotics will show the most growth this year.

MCI reaches settlements with two local telephone companies

By Bryan Wilkins

WASHINGTON, D.C. — MCI Communications Corp. has reached out-of-court settlements in its two most recent antitrust suits against local telephone companies, closing a chapter in its history in which it had to fight to obtain local delivery of its long-distance calls.

MCI reached similar out-of-court settlements with the seven regional holding companies and their local telephone subsidiaries last fall, as well as settlements with six independent telephone companies, including GTE Corp.

The latest two settlements involve suits brought by MCI against the U.S. Telephone Association (USTA) and United Telecommunications, Inc. of Westwood, Kan. The suits charged that the local telephone companies conspired to deny MCI circuits needed to reach customers with MCI service.

The USTA represents hundreds of small telephone companies whose combined coverage serves most of the continental U.S. Two years ago, the divested Bell operating companies were admitted to USTA membership, as was AT&T.

Terms of the settlement were not disclosed, following the precedent set in MCI's earlier settlements. It is widely believed MCI has been able to obtain commitments from the local telephone companies that its connections to the local exchanges will be made on a delivery basis equivalent to AT&T's hookups.

With the latest two settlements, MCI closes its litigation against local phone companies.

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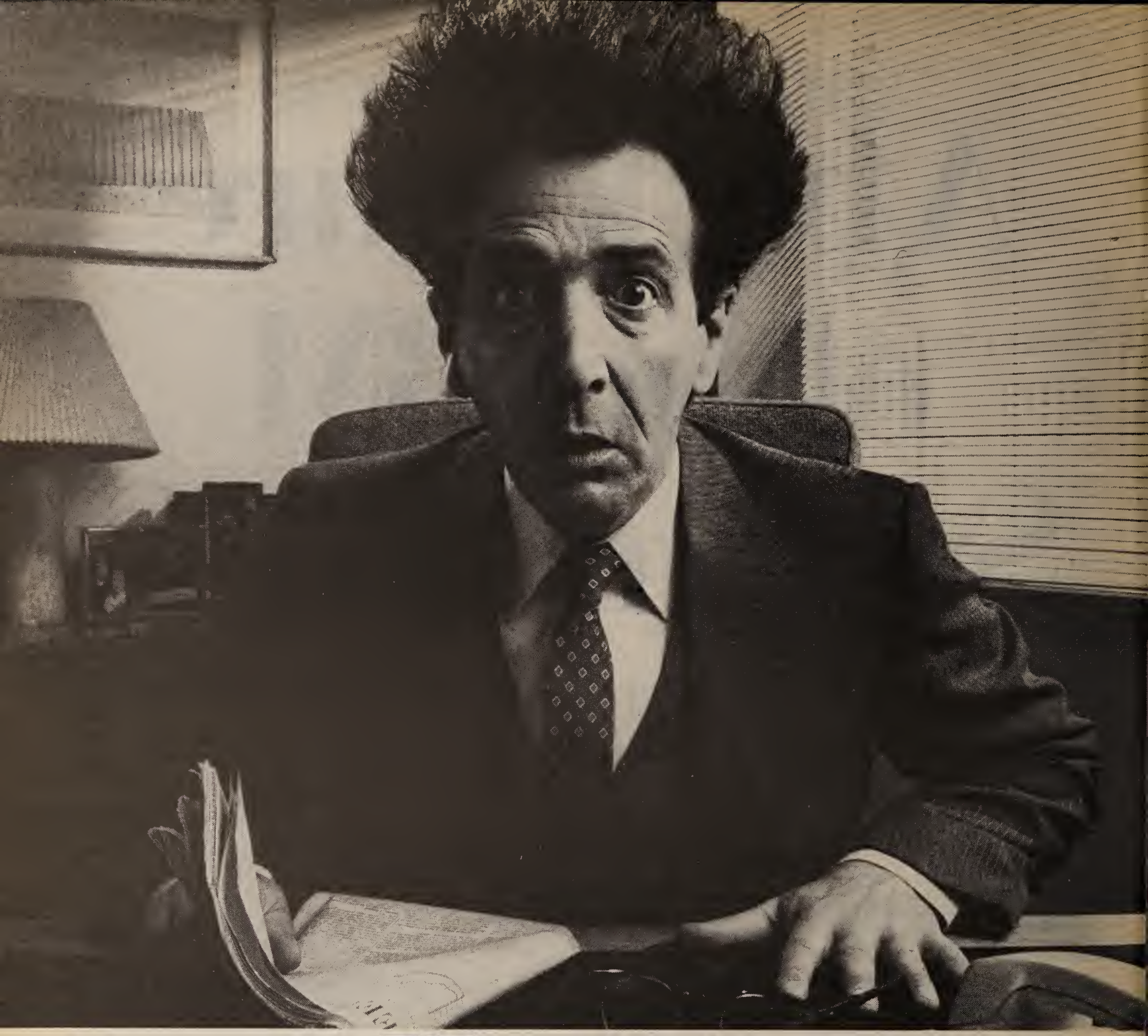

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